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Marine Fisheries REVIEW

National Oceanic and Atmospheric Administration • National Marine Fisheries Service

Marine Fisheries Review

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Cover.—Alaska's marine sport fishery has grown rapidly in recent years. These coho salmon, *Oncorhynchus kisutch*, were taken in the vicinity of Admiralty Island near Juneau. Photo, courtesy of the Alaska Department of Fish and Game.

U.S. DEPARTMENT OF COMMERCE
Frederick B. Dent, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Robert M. White, Administrator

National Marine Fisheries Service
Robert W. Schoning, Director

Address correspondence to: Marine Fisheries Review, NMFS Scientific Publications Staff, Room 450, 1107 N.E. 45th St., Seattle, WA 98105.

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MFR PAPER 1039

Publications and Services of the National Marine Fisheries Service

Compiled by
J. DAVID ALMAND

The National Marine Fisheries Service (NMFS) was established as a part of the National Oceanic and Atmospheric Administration (NOAA) when NOAA was created in October 1970. The basic mission of NMFS is to protect and to promote the wise and full utilization of marine fisheries resources. NMFS thus concerns itself with many aspects of the fisheries, ranging from resource assessment and management to the ultimate use by consumers. In carrying out this mission, NMFS is guided by the following goals:

1. Promote economic, safe, and full utilization of selected commercial and sport fish resources.
2. Effectively conserve and allocate fisheries resources of interest to the United States.
3. Increase U.S. fish production through hatcheries and aquaculture.
4. Insure conservation of fisheries resources in manmade environmental alterations.
5. Protect and conserve marine mammals.

This listing has been compiled to acquaint fishermen, fisheries associations, government agencies, universities, and other interested citizens and groups with the various NMFS publications and services (Table 1). It should also serve as a useful reference in obtaining information on, or taking advantage of, the various publications and services available.

Table 1.—Publications, periodicals, news releases, and major services of the National Marine Fisheries Service.

PUBLICATIONS, PERIODICALS, AND NEWS RELEASES

1. Albacore Fishing Information Bulletins
2. Basic Economic Indicators
3. Canned Fishery Products
4. Catalog of Federal Financial Assistance Available to the U.S. Fishing Industry
5. Data Reports
6. Digest of Congressional Record
7. Fish Charts
8. Fish Cookery Publications
9. Fish Meal and Oil
10. Fish Sticks, Fish Portions, and Breaded Shrimp
11. Fisheries of the United States
12. Fishing Information Reports
13. Fishery Bulletin
14. Fishery Facts
15. Fishery Statistics of the United States
16. Food Fish Facts
17. Food Editor Releases
18. Foreign Fisheries Leaflets
19. Foreign Fishing off U.S. Coasts
20. Frozen Fishery Products
21. Grant-In-Aid for Fisheries Program Activities
22. Gulf Coast Shrimp Data
23. Imports and Exports of Fishery Products
24. Industrial Fishery Products
25. Marine Fisheries Abstracts
26. Marine Fisheries Review
27. Marine Gamefish Newsletters
28. Market News Reports
29. Market Review and Outlook Reports
30. NOAA News Releases (Fisheries)
31. NOAA Technical Memoranda NMFS
32. NOAA Technical Report NMFS CIRC
33. NOAA Technical Report NMFS SSRF
34. Our Living Oceans
35. Processed Fishery Products
36. Production of Fish Fillet and Steaks
37. Safety Placards
38. Saltwater Anglers' Guides
39. Saltwater Angling Survey
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16. Technological Services, Harvesting
17. Technological Services, Processing

Table 2.—National and regional offices of the National Marine Fisheries Service.

U.S. Department of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service Washington, DC 20235 Telephone: (202) 343-4993	Northeast Regional Office Federal Building 14 Elm Street Gloucester, MA 01930 Telephone: (617) 281-0640	Southeast Regional Office Duval Building 9450 Gandy Boulevard St. Petersburg, FL 33702 Telephone: (813) 893-3141
Alaska Regional Office Federal Building P.O. Box 1668 Juneau, AK 99801 Telephone: (907) 586-7221	Northwest Regional Office 1700 Westlake Avenue N. Seattle, WA 98109 Telephone: (206) 442-7575	Southwest Regional Office Room 2016 U.S. Customs House 300 S. Ferry Street Terminal Island, CA 90731 Telephone: (213) 548-2575

Specific NMFS information contacts, in most instances, are incorporated with the description of the publication or service. Where no contact is given, any of the offices listed in Table 2 can supply additional information.

The various publications listed as being available from the Superintendent of Documents (Table 3) or the National Technical Information Service (Table 3) are sales documents. The others are free and can be obtained from the source indicated, through any of the NMFS offices listed in Table 2, or from the Environmental Science Information Center, NOAA, Washington, DC 20235. All NMFS publications sold by the Superintendent of Documents can also be purchased from U.S. Government Printing Office Bookstores. There are Government Printing Office bookstores in: Atlanta, Ga.; Birmingham, Alabama; Boston, Mass.; Canton, Ohio; Chicago, Ill.; Cleveland, Ohio; Dallas, Tex.; Denver, Colo.; Detroit, Mich.; Kansas City, Kansas; Los Angeles, Calif.; New York, N.Y.; Philadelphia, Pa.; San Francisco, Calif.; Seattle, Wash.; and Washington, D.C.

PUBLICATIONS, PERIODICALS, AND NEWS RELEASES

1. **Albacore Fishing Information Bulletins** — These information bulletins, issued every two weeks, during the fishing season (mid-June, through mid-November) contain: (a) short-term projections of albacore distribution; (b) location of productive fishing areas; and (c) oceanic and weather conditions. Fifteen-day sea surface temperature charts for the area between Central Baja California and Vancouver Island out to 135°W are also issued with these bulletins. For more information, contact the Southwest Fisheries Center, (Table 4), La Jolla, Calif. (Also refer to item No. 12, Fishing Information Reports.

2. **Basic Economic Indicators** — These publications, containing extensive compilations of economic, statistical, and biological data for certain major U.S. fisheries or fishery products, are published on an irregular basis. Separate reports have been published for shrimp, menhaden, scallops, halibut, and tuna. Similar reports will be issued on other major species. Available from Technical Information Division, Environmental Science Information Center, Washington, DC 20235.

3. **Canned Fishery Products** — Annual bulletin summarizing the production and value of canned fish and shellfish. Available from the NMFS Statistics and Market News Division, Washington, DC 20235.

4. **Catalog of Federal Financial Assistance Available to the U.S. Fishing Industry** — This publication will describe financial assistance programs of the Federal Government and certain other sources to assist the U.S. fishing industry in furthering its economic progress. It is intended as an educational aid for fisheries businessmen in obtaining information on business loans and related financial assistance programs of the Federal Government. (In preparation.)

5. **Data Reports** — Compilations of unanalyzed or partially analyzed biological, limnological, or oceanographic data available in either microfiche or hard-copy form. Issued irregularly and used mostly by libraries and research scientists and groups. Contact National Technical Information Service, 5285 Port Royal

Table 3.—NOAA, NMFS, and other Federal publications sources mentioned in this article.

International Activities Staff National Marine Fisheries Service Washington, DC 20235	National Marketing Service Office National Marine Fisheries Service 100 East Ohio St., Room 526 Chicago, IL 60611	Division of State-Federal Fisheries Management Relations National Marine Fisheries Service Washington, DC 20235
Legislative Advisor National Oceanic and Atmospheric Administration National Marine Fisheries Service Washington, DC 20235	National Technical Information Service 5285 Port Royal Road Springfield, VA 22151	Public Affairs Office National Marine Fisheries Service Washington, DC 20235
Market Research and Services Division National Marine Fisheries Service Washington, DC 20235	Office of Resource Management National Oceanic and Atmospheric Administration National Marine Fisheries Service Washington, DC 20235	Statistics and Market News Division National Marine Fisheries Service Washington, DC 20235
Technical Information Division Environmental Science Information Center, NOAA Washington, DC 20235		Superintendent of Documents U.S. Government Printing Office Washington, DC 20402

Road, Springfield, VA 22151, for a listing of reports available and prices. (Prices vary depending upon type of publication and whether obtained in hard-copy or microfiche form.)

6. **Digest of Congressional Record** — Daily releases summarizing status of congressional actions and legislation regarding fisheries and related subjects. For information contact the Legislative Advisor, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Washington, DC 20235, Telephone (202) 343-8743. For copies of bills or other congressional publications, write to the appropriate House or Senate Document Room as indicated below.

Document Room
House of Representatives
Room H226—U.S. Capitol
Washington, DC 20515

Document Room
United States Senate
Room S325—U.S. Capitol
Washington, DC 20510

7. **Fish Charts** — Color posters or charts showing various species of marine fish are available for the following geographic areas: California Current and adjacent waters; North Atlantic waters; Gulf and South Atlantic waters; North Pacific waters; and Great Lakes. Additional charts under preparation will show shellfish and marine mammals. Posters are sold by the Superintendent of Documents (Table 3). Cost is about $2.00 each.

8. **Fish Cookery Publications** — These publications present information on how to cook various types of seafood. Copies are sold by the Superintendent of Documents at from 25 to 60 cents per copy. A list of the publications available can be obtained from the Superintendent of Documents or from the NMFS Market Research and Services Division, Washington, DC 20235.

J. David Almand is a member of the Extension Division, Office of Resource Utilization, National Marine Fisheries Service, NOAA, Washington, DC 20235.

9. **Fish Meal and Oil** — Monthly report on the domestic production of fish meal, oil, and solubles. Available from the Statistics and Market News Division, Washington (Table 3).

10. **Fish Sticks, Fish Portions, and Breaded Shrimp** — Quarterly and annual bulletins on production and value of fish sticks, breaded and unbreaded fish portions, breaded shrimp, and imports of fish blocks and slabs. Available from the Statistics and Market News Division, Washington.

11. **Fisheries of the United States** — Annual report with information on the domestic catch, world fisheries, processed products, foreign trade, supply, purchases, prices, per capita consumption, employment, and other information on U.S. fishing industry. Sold by Superintendent of Documents. Cost is about $1.00 per copy (paper bound).

12. **Fishing Information Reports** — Daily radio and/or other periodic reports on the general fishing outlook, sea surface temperatures and other factors for certain fisheries, including albacore, yellowfin and skipjack tuna, billfishes, and menhaden. Additional information on albacore is available from the Southwest Fisheries Center's La Jolla Laboratory (Table 4). More information on skipjack tuna, yellowfin, and billfishes can be obtained from the Southwest Fisheries Center's Honolulu Laboratory, P.O. Box 3830, Honolulu, HI 96812, and, additional information on menhaden is available from the Atlantic Estuarine Fisheries Center (Table 4).

13. **Fishery Bulletin** — A NMFS/NOAA scientific journal published quarterly, and available on a subscription basis ($10.85/year) from the Superintendent of Documents. It contains scientific articles on various fisheries related subjects including biology, economics, technology, fish physiology, and oceanography.

14. **Fishery Facts** — Bulletins geared to specific user groups such as fishermen and processors, which summarize, in nontechnical language, research results and developments on specific topics. This series replaces the "Fishery Leaflet" series and is sold by the Superintendent of Documents, at a per issue cost of from 25 to 50 cents.

Table 4.—Fisheries Centers of the National Marine Fisheries Service.

Atlantic Estuarine Fisheries Center Pivers Island P.O. Box 570 Beaufort, NC 28516	Middle Atlantic Coastal Fisheries Center P.O. Box 428 Highlands, NJ 07732	Seattle, WA 98102
Gulf Coastal Fisheries Center Fort Crockett, Building 302 Galveston, TX 77550	Northeast Fisheries Center Woods Hole, MA 02543	Southeast Fisheries Center 75 Virginia Beach Drive Miami, FL 33149
	Northwest Fisheries Center 2725 Montlake Blvd. E.	Southwest Fisheries Center 8604 La Jolla Shore Drive P.O. Box 271 La Jolla, CA 92037

15. **Fishery Statistics of the United States** — A standard reference for detailed annual statistics by State and region on the domestic fishing industry, this is sold by the Superintendent of Documents.

16. **Food Fish Facts** — Pamphlets written in nonscientific language describing the life history, habitat, fishing methods, distribution and use, and nutritional qualities of various fish and shellfish species. The pamphlets are issued on an irregular basis to food editors by the NMFS's National Marketing Services Office, 100 East Ohio Street, Room 526, Chicago, IL 60611.

17. **Food Editor Releases** — News releases mailed on a regular basis to food editors associated primarily with newspapers and which contain information on seafood nutrition, "best buys," and related consumer

information. The releases are also prepared and distributed by the National Marketing Services Office in Chicago.

18. **Foreign Fisheries Leaflets** — Issued on an irregular basis and describing the fisheries of individual foreign countries, the leaflets are prepared by the NMFS's International Activities Staff, Washington, DC 20235.

19. **Foreign Fishing Off U.S. Coasts** — Monthly reports on fishing activities by foreign fleets off the coasts of the U.S. Prepared by the International Activities Staff, Washington, D.C.

20. **Frozen Fishery Products** — Monthly and annual report on freezings and holdings of fishery products by species and geographical sections. Available from the Statistics and Market News Division, Washington, D.C.

21. **Grant-In-Aid for Fisheries Program Activities** — This is an annual publication summarizing funding, current status, and accomplishments under the Grant-In-Aid Program described under the "Major Services" section of this article. Available from the NMFS's Office of State-Federal Relations, Washington, DC 20235.

22. **Gulf Coast Shrimp Data** — Monthly and annual publications showing shrimp landings by depth and area of capture, species, size, number of trips, and days fished for the Gulf Coast States. Available from the Statistics and Market News Division, Washington, D.C.

23. **Imports and Exports of Fishery Products** — Annual report of quantity and value of imports of fishery products and of exports of domestic products. Available from the Statistics and Market News Division, Washington, D.C.

24. **Industrial Fishery Products** — Annual publication containing information by State on the quantity and value of domestic production and fish scrap and meal, fish and oil solubles, marine pearl and mussel shell buttons, oyster shell grit and lime, animal feed, and other industrial products. Available from the Statistics and Market News Division, Washington, D.C.

25. **Marine Fisheries Abstracts** — Monthly abstract of world literature on fisheries (particularly fishery technology) available on a subscription basis ($6.50/year) from the Superintendent of Documents. The abstracts provide a valuable information reference to anyone having a special interest in fisheries subjects. A coding system is incorporated as an aid in file storage and retrieval.

26. **Marine Fisheries Review** — Monthly periodical which features articles on research, operations, trends and developments in domestic and foreign fisheries. Available on a subscription basis ($12.50/year) from the Superintendent of Documents.

27. **Marine Game Fish Newsletters** — Annual reports, prepared in newsletter format, for all cooperators in the Cooperative Game Fish Tagging Program (including) charter boat associations; and game fish tournament participants and officials (see also item 4, "Major Service" section).

28. **Market News Reports** — Releases that contain information on landings, prices, imports, movements of fishery products, and certain other information regarding current market conditions in the geographic area of coverage. Information on foreign fishing industry developments is also included. The reports are published and mailed three times per week except during the fishing season when they may be published and mailed up to five times per week. The reports are prepared and mailed from the five offices listed in Table 5.

29. **Market Review and Outlook Reports** — Quarterly Situation and Outlook Reports are published separately for: Food Fish, Industrial Fishery Products, and Shellfish. These reports analyze the current market situation for major U.S. fisheries and contain an outlook concerning future economic conditions. Available from the Superintendent of Documents.

30. **NOAA News Releases (Fisheries)** — News releases regarding NMFS programs, accomplishments, and other newsworthy information on fisheries related subjects are issued on an irregular basis. These and other NOAA news releases can be obtained by contacting the Public Affairs Officer, National Marine Fisheries Service, Washington, DC 20235. Telephone: (202) 343-4881.

31. **NOAA Technical Memoranda** — Publications prepared primarily by NMFS research centers and laboratories designed to present scientific and technical studies that are mainly of local interest. Separately numbered subseries are available for each of several units within NMFS. Contact the National Technical Information Service (Table 3) for specific memoranda available and prices '(usually about $3.00 per copy).

32. **NOAA Technical Report NMFS CIRC** — Publications on fishery subjects of a technical nature available on a per issue basis. The Reports review broad areas of research in considerable detail and are intended to aid fishery management agencies or groups and to provide helpful information to industry. Sold by Superintendent of Documents at about 50 cents per copy.

33. **NOAA Technical Report NMFS SSRF** — Special scientific reports on fishery subjects, which document long-term or continuing scientific investigations of NMFS or which provide an intensive report on a study of restricted scope. Bibliographies of a specialized nature may also be published in this series. The Reports are designed primarily for scientific or technical audiences and are available on a per issue basis. Sold by the Superintendent of Documents at from 25 cents upward.

34. **Our Living Oceans** — Pamphlets published on an irregular basis that contain information on living marine resource subjects of general interest. The series is primarily aimed at the 8 to 18 age group.

35. **Processed Fishery Products** — Annual statistical publication on

Table 5.—NMFS offices which prepare and mail *Market News Reports*.

Statistics and Market News Division
National Marine Fisheries Service
Room 2016, U.S. Customs House
300 S. Ferry Street
Terminal Island, CA 90731

Statistics and Market News Division
National Marine Fisheries Service
546 Carondelet St., Room 412
New Orleans, LA 70130

Statistics and Market News Division
National Marine Fisheries Service
Room 10, Commonwealth Pier
Boston, MA 02210

Statistics and Market News Division
National Marine Fisheries Service
201 Varick Street
New York, NY 10014

Statistics and Market News Division
National Marine Fisheries Service
7018 Federal Office Building
909 First Street
Seattle, WA 98104

quantity and value of all processed fishery products by geographic region and for American Samoa and Puerto Rico. Data on the number of processing and wholesaling establishments as well as data on employment are also included. Available from the Statistics and Market News Division, Washington, D.C.

36. **Production of Fish Fillets and Steaks** — Annual publication on domestic production and value of fish fillets and steaks by species and area of production. Available from the Statistics and Market News Division, Washington, D.C.

37. **Safety Placards** — Informational placards that contain a safety related message. The placards are waterproof and suitable for posting in a conspicuous location on a fishing vessel or dock.

Three placards have recently been released. The first deals with "Helicopter Evacuation" of crew members or passengers from vessels in distress or of any individual in a "life or death" situation. The second placard relates to "Medical Assistance Available to Vessels" and tells how vessel operators can obtain medical assistance in emergency situations. The Medical Assistance placards have been prepared for each of four geographical areas; the South Atlantic, Gulf and Caribbean waters; the California, North Pacific, and Alaska waters; Hawaiian waters; and the North and Middle Atlantic waters. The third discusses the handling of explosives caught in fishing gear. Placards are available from Regional NMFS Offices.

38. **Saltwater Anglers' Guides** — Two separate publications, one of which is prepared for the East Coast of the United States, the other for the West Coast and Hawaii. The publications contain information on the best locations and time of year to fish, species to be caught, and other information relating to saltwater sportfishing. These publications will be sold by the Superintendent of Documents.

39. **Saltwater Angling Survey** — Publication containing statistical data on saltwater sportfishing by fishing method, species, and geographic region, based on a national survey conducted once every five years. Available from the Superintendent of Documents at about 85 cents each.

40. **Sectional Summaries** — Annual bulletins showing commercial landings for the United States fisheries and 10 major geographic sections as follows: Alaska fisheries, Chesapeake fisheries, Great Lakes fisheries, Gulf fisheries, Hawaii fisheries, Middle Atlantic fisheries, Mississippi River fisheries, New England fisheries, Pacific Coast fisheries, and South Atlantic fisheries. Available from the Statistics and Market News Division, Washington, D.C.

41. **Shrimp Landings** — Monthly and annual statistical bulletins on shrimp landings by species and by count, in the Gulf and South Atlantic States. Available from the Statistics and Market News Division, Washington, D.C.

42. **State Landings Bulletins** — Monthly and annual bulletins issued by the Statistics and Market News Division, Washington, D.C. for most coastal States, showing value and volume of landings by port, county, or district, area of capture, and catch by gear. Bulletins presently issued: Alabama, Florida, Georgia, Louisiana, Maine, Maryland, Massachusetts, Mississippi, New Jersey, New York, North Carolina, Rhode Island, South Carolina, Texas, and Virginia.

43. **Simplified Recordkeeping Sheets (SRS) for Fishermen** — An educational aid to assist fishing vessel operators in maintaining business records relating to their vessel and in recording information for tax reporting purposes. The forms are specifically intended for fishermen who do not use the services of "settlement houses" or accountants for maintaining and analyzing their business records.

44. **Subject Matter Index** — This publication provides a ready reference of NMFS expertise in selected subject areas. The index is in two parts: a subject matter listing and an information directory. Part I of the Index contains an alphabetical listing of

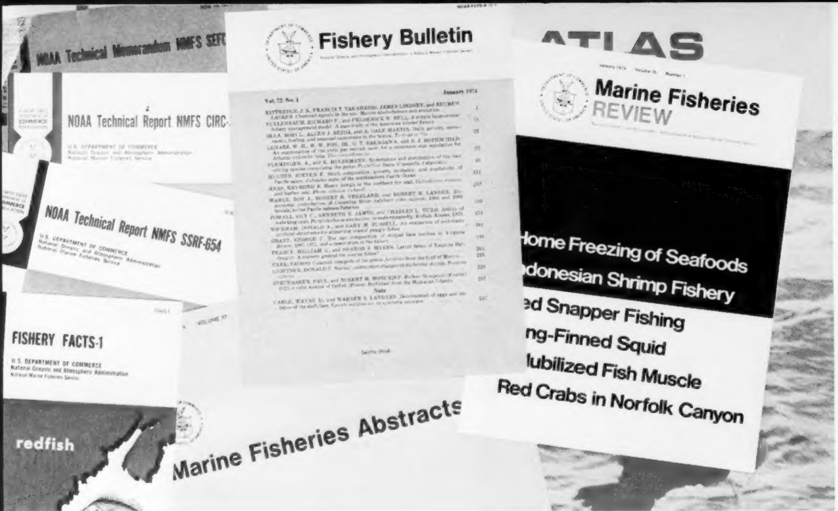
Table 6.—NMFS Fishery Product Inspection offices.

Division of Fishery Products Inspection
National Marine Fisheries Service
4747 Eastern Ave. Bldg. 7
Bell, CA 90201

Division of Fishery Products Inspection
National Marine Fisheries Service
Duval Building
9450 Gandy Blvd.
St. Petersburg, FL 33702

Division of Fishery Products Inspection
National Marine Fisheries Service
P.O. Box 1188
Emerson Avenue
Gloucester, MA 01930

Division of Fishery Products Inspection
National Marine Fisheries Service,
1700 Westlake Ave. N.
Seattle, WA 98109



Publications play an important role in NMFS programs.

most subjects in which NMFS possesses expertise. Cross-referenced to these subject listings are information codes, by geographic region, which identify specific offices within NMFS that have expertise relative to the corresponding subject areas. Part II consists of six geographic directories that contain (a) information codes, (b) information sources, and (c) their corresponding information numbers.

45. **Translations** — Published listings of translated Tables of Contents and publications regarding foreign fisheries and oceanographic related items. For information, contact the International Activities staff, Washington, D.C. (Table 3).

OVERVIEW OF MAJOR SERVICES

1. **Administration of Pribilof Islands** — The NMFS administers the Fur Seal Act of 1966 which directs NMFS to protect and manage the fur seal resources of the Pribilof Islands located off the coast of Alaska. The Act also provides for the care and welfare of the native islanders. In fulfilling these responsibilities, NMFS conducts research on the management and harvest of fur seals and provides employment, housing, and educational services to the Aleut residents of the Pribilof Islands. Additional information on these services can be obtained from the Office of Resource Management, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Washington, DC 20235.

2. **Advisory Services** — In December 1972, the National Oceanic and Atmospheric Administration established the NOAA Marine Advisory Service (NMAS) to promote and disseminate knowledge on use and development of marine fisheries and other ocean and Great Lakes resources through an informal education program whereby research results, availability of services, experience of industry, and other sources of information are quickly made available to the users.

The principal components of NMAS are State and local Sea Grant Advisory Programs and the various NOAA organizations. It is a national system for helping fishermen and other marine resource users solve practical problems through informal education. The State and local advisory staffs emphasize personal contact and other direct fieldwork at the community level. The local field staffs are backed up and supported by the total resources of NOAA, Sea Grant universities, and many other cooperating agencies and institutions.

The various services described in this listing are among the activities which provide direct support to the NMAS program. NMFS field offices and research installations also provide valuable backup to marine advisory agents by serving as a source of talent and expertise. In addition, NMFS experts throughout the country cooperate with a variety of fisheries related groups in providing information and technical expertise to the fishing industry. Each NMFS region now has at least one extension specialist that serves somewhat as a focal point for advisory work within each of the five regions.

3. **Artificial Reefs** — NMFS provides advice and technical assistance regarding the location, construction, and ecology of manmade reefs in the marine environment. These reefs provide new habitat for fish and other organisms and serve as productive fishing areas for saltwater anglers. For additional information contact the Atlantic Estuarine Fisheries Center in Beaufort, N.C. (Table 4).

4. **Cooperative Gamefish Tagging and Recovery** — NMFS serves as a clearinghouse in connection with research activities regarding the life history and migration patterns of oceanic gamefish. These activities are carried out in cooperation with saltwater angling clubs and groups and often involve participation of NMFS scientists in collecting data during saltwater fishing tournaments. Fish tags and tagging instructions are provided by NMFS. The actual tagging of fish is performed by the angler or by charter boat operators. For additional information contact the Northwest Fisheries Center, Seattle, Wash.; Northeast Fisheries Center, Woods Hole, Mass.; Southwest Fisheries Center, La Jolla, Calif.; or the Southeast Fisheries Center in Miami, Fla. (Table 4).

5. **Enforcement and Surveillance** — The NMFS has a specialized Federal enforcement program involving marine fish and mammals. The present enforcement and surveillance responsibilities involve (1) the development, promulgation, and enforcement of domestic fisheries regulations required under the authority of international fisheries agreements to which the United States is a contracting party; and (2) compliance by foreign fishing vessels of the contiguous fisheries zone and territorial waters. Also included is enforcement of U.S. statutes concerning

marine mammal protection, and prohibiting possession or importation of illegally taken fish and wildlife; surveillance of foreign fishing operations to ensure compliance with the provisions of various treaties and agreements to which the U.S. is a party; and collecting intelligence on foreign fishing fleets off the United States needed for enforcement and for negotiations regarding foreign fishing. That portion of the fisheries enforcement program which involves activities at sea is largely planned and conducted in cooperation with the U.S. Coast Guard. Under this arrangement, the Coast Guard provides aerial and surface patrols and NMFS provides agents with fisheries expertise to accompany these patrol efforts.

6. **Environmental Impact Analysis** — NMFS provides consultative services, under the authority of the Fish and Wildlife Coordination Act, as amended, to other Federal agencies regarding the impacts of water development projects on fish and wildlife resources and their habitat. Specific areas of responsibility include marine fisheries, anadromous fishes, fresh water commercial fisheries, and marine mammals. Recommendations are made to prevent loss of, mitigate damages to, or enhance the populations of those resources. NMFS also provides consultative services to Federal regulatory agencies that grant permits and licenses for construction and waste discharges in the aquatic environment. In accordance with certain provisions of the National Environmental Policy Act, NMFS expertise is further brought to bear on environmental impact statements through a review and comment process.

7. **Financial Assistance** — The NMFS operates four financial assistance programs to assist the fishing industry: Capital Construction Fund, Fisheries Loan Fund, Fishermen's Guaranty Fund Program, and the Fishing Vessel Obligation Guarantee Program.

The **Capital Construction Fund** allows fishermen to accumulate tax deferred funds for the construction, reconstruction and/or acquisition of commercial fishing vessels. Through an agreement with the Department of Commerce, fishermen already owning commercial fishing vessels are permitted to make certain tax deferred deposits which are scheduled for later withdrawal for construction, reconstruction, or acquisition. These deposits may consist, in any given year, of earnings from fishing activities, depreciation on existing vessels, net proceeds from the sale of existing vessels, and/or insurance proceeds attributable to those vessels. Although taxes on those deposits are deferred, the depreciation basis of vessels purchased or reconstructed with the aid of withdrawals from a fund is adjusted to reflect those withdrawals.

The **Fisheries Loan Fund** is a revolving fund from which loans are available to finance or refinance the cost of purchasing, constructing, equipping, maintaining, repairing, or operating new or used commercial fishing vessels or gear. A fund moratorium was declared on 1 March 1973. The moratorium will probably continue until 1 July 1974. A new program is being developed to use the limited means available to the Fund in a more effective manner.

The **Fishermen's Guaranty Fund Program** provides for reimbursement to owners of U.S.-flag vessels for certain losses and costs incurred as a result of a vessel seizure by a foreign country claiming territorial jurisdiction in waters regarded by the United States as the high seas. Participation is by agreement and payment of fees.

The **Fishing Vessel Obligation Guarantee Program** authorizes Commerce Department guarantee of obligations which aid in financing or refinancing up to 75 percent of the cost of construction, reconstruction, or reconditioning of commercial fishing vessels. Repayment period ordinarily may not exceed 15 years (construction) or 7 years (reconstruction or reconditioning). Permissible interest rates are determined by the Secretary on the basis of prevailing rates in the private market and the risks assumed by the Department. A lender with a guaranteed obligation will not be a party to the security arrangements made between the Commerce Department and the borrower. The lender's sole security will be the U.S. guarantee of the borrower's obligation.

8. **Fish Forecasting Services** — Forecasts of abundance are made for selected fish populations including menhaden, North Atlantic groundfish, and tuna. Radio facsimile broadcasts are made to tuna fishermen in the tropical Pacific in a cooperative fishery advisory monitoring service between fishermen and scientists at the Southwest Fisheries Center. Abundance forecasts for other species (anchovies, hake, sardines, etc.) are also provided as required. Industry advisories are also issued to the menhaden industry and state fishery agencies on a semimonthly basis along with annual forecasts of abundance and availability by the Atlantic Estuarine Fisheries Center.

The Northeast Fisheries Center prepares quarterly and annual stock catalogues for industry and an annual abundance forecast for the Atlantic States Marine Fisheries Commission regarding the status of groundfish stocks off the northeast coast of the U.S. Similar information is available for important fishery resources of the North Pacific (salmon, hake, shrimp, halibut, crabs, and other species) from the Northwest Fisheries Center. Such information for the Gulf of Mexico, the southeast coastal region, and the western Caribbean is available from the Southeast Fisheries Center and from the Gulf Coastal Fisheries Center in Galveston (primarily Gulf of Mexico shrimp). Additional information on these forecasting services is available from the above NMFS Fisheries Centers (Table 4) and the Middle Atlantic Coastal Fisheries Center, Milford, CN 06460.

9. **Fishery Products Inspection and Grading Services** — NMFS provides inspection and grading services to help the fishing industry (producers, processors, and distributors) upgrade and maintain the quality of their fresh, frozen, canned, or cured products during the whole chain from producer to final user, including products of both domestic and international origin. The major components of the service are inspection and grading.

Inspection is provided on a fee for service basis, under either a contractual arrangement or on a product lot basis. Contract inspection involves the monitoring, examination, and certification of facilities, equipment, and products during production, processing, and packing, by trained inspectors, to make certain that products are safe, wholesome, properly labeled, and that the food-handling personnel working within the processing confines meet well defined food handling practices and principles. Products packed under such an arrangement, and which pass all Federal requirements may bear on their brand labels the Federal mark or statement "Packed Under Federal Inspection."

Lot inspection involves the examination and certification of specified lots of fishery products by trained inspectors upon request by anyone with a financial interest in the product. It may be located in processing plants, public warehouses, distribution points, etc. Products examined under this service cannot bear Federal inspection symbols.

Grading is an added step under contract inspection in which the trained inspector determines and certifies as to the grade of products produced, in accordance with published U.S. Grade Standards. Such products are eligible to bear a "U.S. Grade" shield in addition to the Federal inspection mark.

The inspection and grading programs are efforts to increase consumer confidence and promote wider acceptance and use of fishery products through industry quality assurance programs and brand label marketing efforts. Further information regarding these services is available from the NMFS offices listed in Table 6.

10. **Foreign Fishing Vessel Transfers** — The NMFS provides consultative services to the Maritime Administration (MARAD) on all applications to MARAD involving requests for approval for the transfer of U.S. fishing vessels to foreign ownership or registry pursuant to provisions of the Shipping Act, 1916. NMFS views are solicitied to ensure that all transfers are consistent with the wise use of fisheries resources.

11. **Grants-In-Aid** — NMFS administers Grants-In-Aid programs under the two legislative acts described below.

The Commercial Fisheries Research and Development Act of 1964 (P.L. 88-309), as amended. Authorizes the Secretary of Commerce to cooperate with the 50 States, the Commonwealth of Puerto Rico, and the Governments of the Virgin Islands, Guam, and American Samoa in carrying out research and development of the Nation's commercial fisheries. Projects eligible for funding include research, development, construction, and coordination. Cost-sharing projects are funded at either a 50 percent or 75 percent level of Federal participation, whereas projects to alleviate resource disaster are financed with 100 percent Federal funds.

The Anadromous Fish Act of 1965 (P.L. 89-304), as amended. Authorizes the Secretary of Commerce to enter into cooperative agreements with State or other non-Federal interests for the conservation, development, and enhancement of the anadromous fishery resources of the nation and the fish in the Great Lakes that ascend streams to spawn. The program is administered at the Federal level jointly by the National Marine Fisheries Service and the Bureau of Sport Fisheries and Wildlife. Federal funds up to 50 percent and, in certain cases, up to 60 percent, may be used to finance project costs. State fishery agencies, colleges, universities, private companies and other non-Federal interests in 30 States bordering the oceans and the Great Lakes may participate under the Act. All projects must be approved by the State fishery agency concerned.

12. **Lake Washington Sockeye Salmon Acoustical Surveys** — In cooperation with the Fisheries Research Institute of the University of Washington, Seattle, and the Washington State Department of Fisheries, the Northwest Fisheries Center conducts weekly acoustical surveys of Lake Washington during June, July, and August. Concentrations of sockeye salmon adults are detected and news releases, in turn, issued to local newspapers immediately after each survey. These releases contain a chart showing areas of salmon concentrations and the depth distribution of the fish. Sport fishermen utilize this information in fishing for sockeye salmon.

13. **Marine Mammals** — In carrying out its responsibilities under the Marine Mammal Protection Act of 1972 for whales, porpoises, seals, and sea lions, NMFS reviews and either approves or disapproves: (a) economic hardship exemptions; (b) applications for permits to harvest marine mammals for scientific research purposes; and (c) applications for permits to publicly display marine mammals. NMFS also conducts public hearings and issues regulations on various aspects of the program relative to implementation of the Act.

14. **Marine Resource Assessment and Prediction** — NMFS conducts a marine resource assessment program (MARMAP) which represents a total system for resource assessment and prediction, including information on the abundance, distribution, and condition of actual and potential marine resource populations available to the United States. Information generated by MARMAP is based on ichthyoplankton, groundfish, and pelagic surveys, and fishery catch analyses for resources of interest to the United States in Atlantic, Pacific, and Gulf

of Mexico waters. Environmental data taken in conjunction with surveys by other agencies are also used. Additional information regarding these surveys is available from the Northeast Fisheries Center, Northwest Fisheries Center, Middle Atlantic Coastal Fisheries Center, Southwest Fisheries Center, Southeast Fisheries Center, and the Gulf Coastal Fisheries Center.

15. **Marketing Services —** Marketing Services include Market Development, Consumer Education, and Market Intelligence. Market Development is designed to provide assistance to the industry in identifying and developing new and expanded domestic and foreign markets, primarily for latent or underutilized fishery products. Specific activities include identification of possible markets for new products, a determination of the volume of the new product that can be marketed in given locations, assisting industry in introducing the product in the market place, and providing technical marketing assistance to fishery product processing or marketing firms.

Consumer Education helps provide consumers with greater knowledge regarding the purchasing and preparation of seafood products. Activities include development, production, and distribution of consumer education materials, conduct of fish cookery presentations and demonstrations with emphasis on latent species, conducting seafood related training for various State and industry home economists, and consultations with State and industry associations.

The purpose of the Market Intelligence program is to analyze factors which affect current market conditions for fishery products (such as prices, imports, exports, production, inventories, and consumption) and to prepare forecasts.

16. **Technological Services, Harvesting —** NMFS conducts research and development activities regarding various types of fishing gear, equipment and techniques. Current work is oriented primarily toward the development and testing of gear and techniques for three basic purposes: (1) more efficient resource assessment through improved sampling; (2) conservation of living marine resources; and (3) encouragement of more efficient harvesting. NMFS collaborates with members of the U.S. fishing industry in testing and promoting new gear and techniques to achieve the three basic purposes mentioned above. Additional information can be obtained from: Middle Atlantic Coastal Fisheries Center, P.O. Box 428, Highlands, NJ 07732; Northeast Fisheries Center, Southeast Fisheries Center; Northwest Fisheries Center; Southwest Fisheries Center; or the Gulf Coastal Fisheries Center (Table 4).

17. **Technological Services Processing —** NMFS also conducts research and development activities necessary to provide assistance to the fishing industry in solving technological problems relating to the seafood processing industry. This includes work relating to the development of products from underutilized fishery resources, new seafood processing and handling methods, microconstituents in fishery products, aquaculture technology, pollution control, and fishery products safety and nutrition. Technical information is also provided concerning the nutritional value composition, proper and safe handling, and preservation of fishery food products in the home. The various research and technological assistance activities are carried out at the NMFS facilities listed in Table 7.

Table 7.—Fishery Products Technology Centers and Laboratories of the National Marine Fisheries Service.

Atlantic Fishery Products Technology Center	Emerson Avenue, Gloucester, MA 01930
College Park Fishery Products Technology Laboratory	Regents Drive, University of Maryland Campus, College Park, MD 20740
Kodiak Fishery Products Technology Center	P.O. Box 1036, Kodiak, AK 99615
Pacific Fishery Products Technology Center	2725 Montlake Boulevard East, Seattle, WA 98102
Pascagoula Fishery Products Technology Laboratory	3209 Frederick Street, P.O. Drawer 1207, Pascagoula, MS 39568

MFR Paper 1039. From Marine Fisheries Review, *Vol. 36, No. 3, March 1974. Copies of this paper, in limited numbers, are available from D83, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235.*

MFR PAPER 1040

The American eastern tropical Atlantic tuna fleet records its second highest total catch.

Participation by Panamanian and U.S. Seiners in 1972 Tuna Fishery of the Eastern Tropical Atlantic

GARY T. SAKAGAWA

ABSTRACT

American participation in the 1972 eastern tropical Atlantic tuna fishery is reviewed. For the American fleet (Panamanian and U.S. seiners) the 1972 season was successful in terms ot total catch of 24,200 metric tons of tuna, second highest recorded (highest was the 1969 catch of 24,300 metric tons) since significant numbers of American vessels first participated in the fishery in 1967. Catches, catch rates, fishing areas, and sizes of yellowfin and skipjack tunas caught by the American fleet in 1972 are discussed.

INTRODUCTION

From April through November 1972, 33 American purse seiners[1] fished off west Africa between lat. 30°N and lat. 20°S and east of long. 25°W (the eastern tropical Atlantic). A total of 12,000 metric tons of yellowfin tuna (*Thunnus albacares*) and 12,200 metric tons of skipjack tuna (*Katsuwonus pelamis*) were caught in 3,700 vessel-days of fishing. The total American catch (yellowfin and skipjack) from the eastern tropical Atlantic was 18 percent and fishing effort was 128 percent greater than in 1971. The number of boats, total fishing effort, and length of the season were the highest recorded for the fleet since 1967 when significant numbers of American vessels first participated in the eastern tropical Atlantic tuna fishery (Sakagawa and Lenarz, 1972). A review of the American participation in the 1972 fishery is presented in this report.

[1]American purse seiners refer to vessels flying the flags of Canada, Panama, or the United States. In 1972 no Canadian seiners participated in the eastern tropical Atlantic tuna fishery. The 1972 American fleet consisted of 32 Class 6 vessels (greater than 363 metric tons capacity) and one Class 3 vessel (92-181 metric tons capacity).

TOTAL ATLANTIC CATCH OF YELLOWFIN AND SKIPJACK TUNAS

Preliminary catch statistics, which include principally all significant catches except that of the Taiwanese longline fleet, indicate that the total Atlantic catch (all fleets) of yellowfin tuna in 1972 will exceed the 1971 catch and probably also exceed the all-time high of 92,400 metric tons, which was recorded in 1969 (Figure 1). The increase in the 1972 yellowfin catch occurred primarily in the surface fishery with the American contribution showing improvement from a downward trend which began in 1970 (Sakagawa and Lenarz, 1972).

Gary T. Sakagawa is a fishery biologist with the NMFS's Southwest Fisheries Center, La Jolla, CA 92037.

The total Atlantic catch (all fleets) of skipjack tuna, on the other hand, decreased 18 percent in 1972 from an all-time high of 86,500 metric tons in 1971 (Figure 1). In the American total catch, skipjack and yellowfin tuna contributed about equally, based on weight. This was markedly different from the 79 percent skipjack—21 percent yellowfin composition of the 1971 American catch (Sakagawa and Lenarz, 1972).

MONTHLY CATCHES AND CATCH RATES IN THE EASTERN TROPICAL ATLANTIC

The year 1972 was the first in which the American purse seine fleet entered the eastern tropical Atlantic fishery as early as April. This early entry was largely due to the record early closing (5 March 1972) of the eastern tropical Pacific yellowfin tuna fishery (IATTC, 1973). Most of the 33 American vessels participating in the Atlantic fishery had been in the

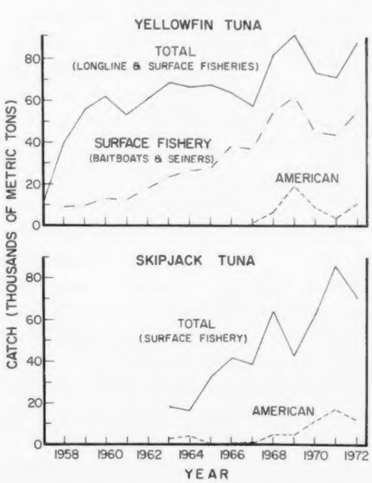


Figure 1.—Total catch of yellowfin and skipjack tunas in the Atlantic Ocean—all fisheries. 1972 figures are preliminary and incomplete.

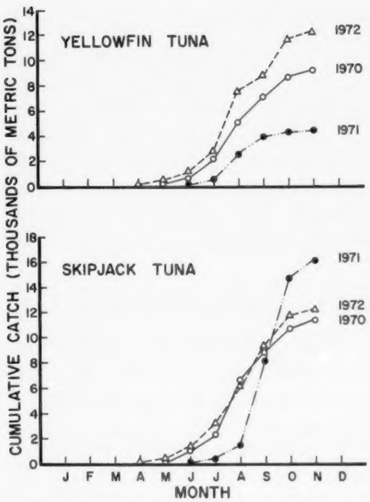


Figure 2.—Cumulative catch of yellowfin and skipjack tunas by the American fleet in the eastern tropical Atlantic, 1970-72.

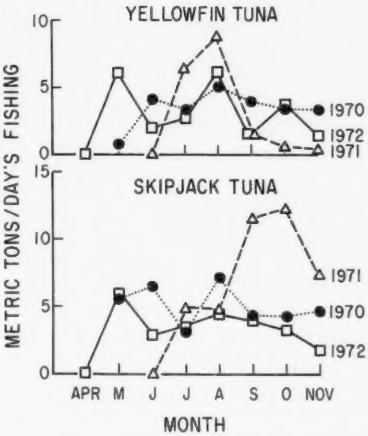


Figure 3.—Monthly catch rates of American seiners in the eastern tropical Atlantic tuna fishery, 1970-72.

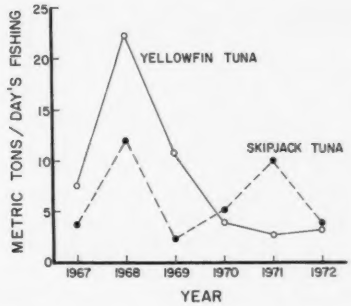
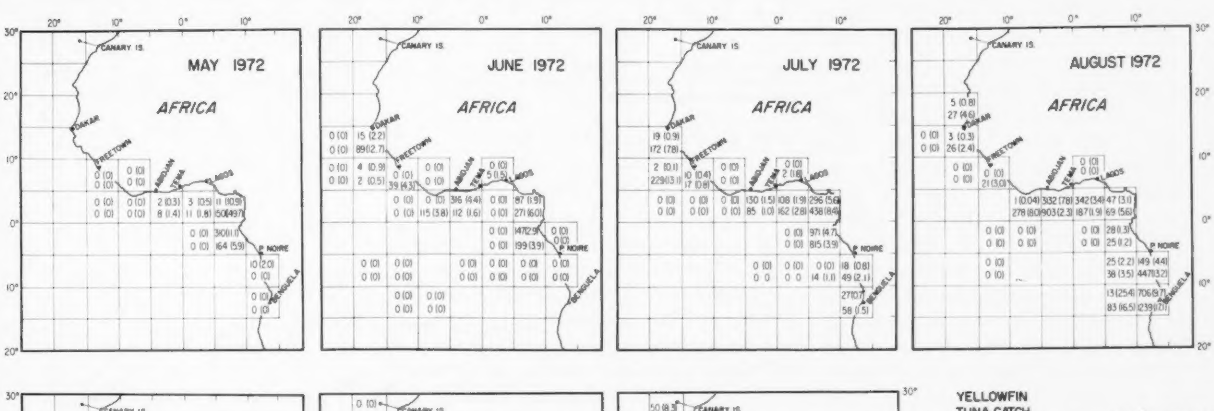
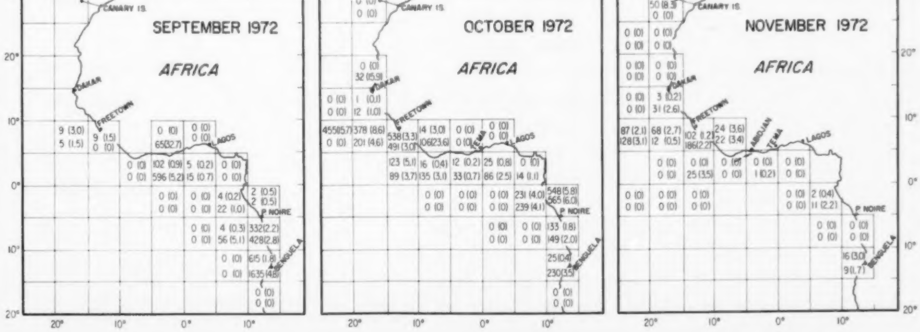


Figure 4.—Annual catch rates of American seiners in the eastern tropical Atlantic tuna fishery, 1967-72.

Pacific yellowfin fishery just before and when it closed. The amount of effort expended by the American fleet in April, however, was too small to be indicative of average fishing conditions for that month; therefore, the catch and catch rate for April are not discussed in this report.

Although the American fleet entered the fishery earlier in 1972 than in previous years, the pattern of monthly catches of yellowfin tuna followed fairly closely the pattern of 1970, but at a slightly higher level (Figure 2). About 41 percent of the 1972 catch of yellowfin tuna was made in August and 74 percent in the 3





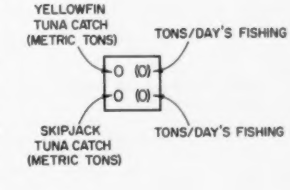


Figure 5.—Catch and catch rate of yellowfin and skipjack tunas in 5° × 5° areas by month by American seiners in 1972.

months, August-October. Fishing for yellowfin tuna was good in May and August (6.1 metric tons/day's fishing) and poor in September and November (1.5 metric tons/day's fishing Figure 3). For the season as a whole the catch rate was 3.3 metric tons of yellowfin tuna/day's fishing, slightly higher than the 1971 rate (Figure 4).

The pattern of skipjack catches was nearly identical to that of 1970 (Figure 2). About 70 percent of the total 1972 skipjack catch was made in August-October. Fishing for skipjack was good in May (6.1 metric tons/day's fishing) and poor in November (1.8 metric ton/day's fishing, Figure 3). For the season as a whole the catch rate was 3.7 metric tons of skipjack tuna/day's fishing, well below the 1971 rate of 10.0 metric tons/day's fishing (Figure 4).

"BEST" FISHING AREAS IN THE EASTERN TROPICAL ATLANTIC

In May-July 1972 the "best" areas of fishing, in terms of high catch rates (considering only 5° × 5° areas in which five or more fishing days were expended in a month), for the American purse seine fleet were generally in the northern part of the Gulf of Guinea for yellowfin tuna and off Portuguese Guinea for skipjack tuna (Figure 5). In August, high catch rates were also obtained in the northern part of the Gulf of Guinea, but the "best" fishing area was off Benguela, Angola (lat. 10°S and long. 10°E), where 9.7 metric tons of yellowfin tuna/day's fishing and 17.1 metric tons of skipjack tuna/day's fishing

Table 1.—Areas of "best" fishing for American seiners, 1972.

Month	Yellowfin tuna	Skipjack tuna
Apr.	(Insufficient data)	(Insufficient data)
May	Congo	Congo
June	Ghana-Ivory Coast	Portuguese Guinea
July	Gabon	Portuguese Guinea-Sierra Leone
Aug.	Angola	Angola
Sept.	Angola	Ghana-Ivory Coast
Oct.	Liberia-Sierra Leone	Angola; Liberia-Sierra Leone
Nov.	Canary Islands; Liberia-Sierra Leone	Liberia-Sierra Leone

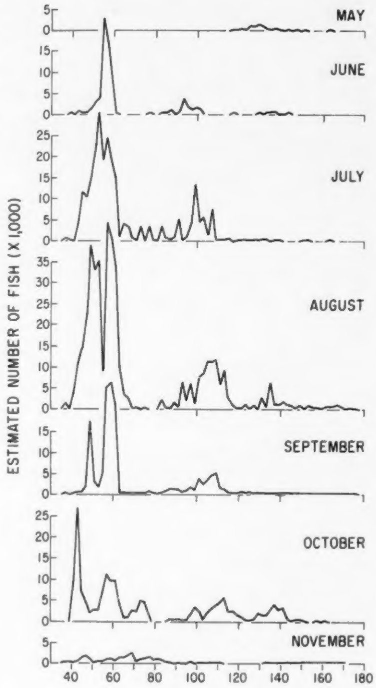


Figure 6.—Length-frequency distributions of yellowfin tuna caught by American seiners in the eastern tropical Atlantic, 1972.

were caught (Figure 3). In September, the fleet had overall poor fishing, but the "best" skipjack fishing was off Angola (lat. 10°S and long. 10°E), Ghana and the Ivory Coast (lat. 0° and long. 0°), and "best" yellowfin fishing, off Angola. A northward shift in "best" fishing grounds occurred in October and November, with the "best" fishing off Sierra Leone and Liberia (lat. 5°N and long. 15°W) and as far north as the Canary Islands (lat. 25°N and long. 15°W). In October, there was also reasonably good fishing, especially for yellowfin tuna, off Congo and Gabon (lat. 0°S and long. 5°E). A summary of the "best" fishing areas for the American fleet by month for 1972 is given in Table 1.

In 1972 some fishing effort was expended at considerable distances offshore (>570 km) but no tunas were caught (Figure 5). The amount of effort, howevever, was small (about 1 percent of total), so the results may not be indicative of the areas' potential as a source of tuna for the surface fishery. More exploration is needed to determine whether the total yield of especially yellowfin tuna might be substantially increased if the surface fishery expanded its operations farther offshore, as occurred in the eastern Pacific yellowfin tuna fishery (Joseph, 1970).

SIZE COMPOSITION OF CATCH

Three age groups of yellowfin tuna were principally caught by the American purse seine fleet in 1972. About 70 percent of the catch in numbers was 1-year-old fish (35-70 cm), 24 percent, 2-year-old fish (71-125 cm) and 4 percent, 3-year-old fish (126-150 cm). July through November were the best months for catching 1-year-old and 2-year-old yellowfin tuna, and May, August, and October were best for

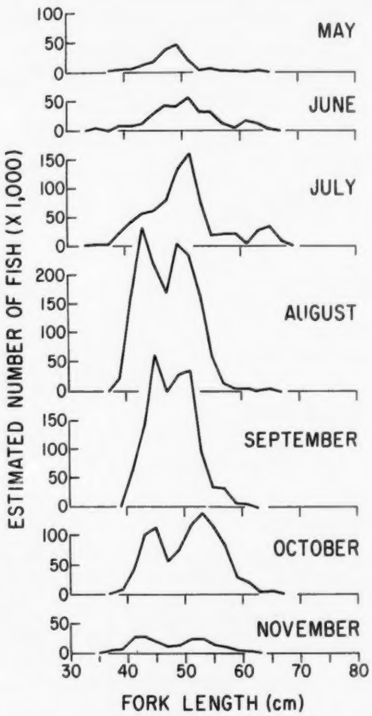


Figure 7.—Length-frequency distributions of skipjack tuna caught by American seiners in the eastern tropical Atlantic, 1972.

catching 3-year-old fish (Figure 6). The average length of yellowfin tuna in the total American catch was 70 cm.

Considerably more skipjack tuna in numbers than yellowfin tuna were caught in 1972 (5.3 million skipjack versus 1.1 million yellowfin). Exploitation was principally on the young-of-the-year (in the size range of 32-55 cm), but some 1-year-old skipjack (about 65 cm long) were also caught (Figure 7). The average length of skipjack tuna in the American catch was 49 cm.

SIGNIFICANCE OF RESULTS

In 1972, the International Commission for the Conservation of Atlantic Tuna (ICCAT) adopted a minimum size limit of 3.2 kg (55 cm) for yellowfin tuna with a provision that incidental catches of yellowfin tuna below this minimum size should not exceed 15 percent of the total yellowfin catch by number. This regulation was slated to begin in 1973, and, therefore, did not affect the 1972 fishery. If such a regulation had been enforced in 1972, as much as 8 percent, or about 1,000 metric tons, of yellowfin caught by the American fleet in that year could not have been landed.

Although fishing effort of the American fleet increased 106 percent in 1972 over that of 1969, the year of the largest American catch of yellowfin tuna (Figure 1), the yellowfin catch decreased 39 percent. The catch rate of yellowfin tuna also decreased from 11 metric tons/day's fishing to 3 metric tons/day's fishing (Figure 4), and the average length of yellowfin in the catch decreased from 122 to 70 cm. Probable causes for this are: variable recruitment strength, e.g., 2-year-olds were the dominant age group in 1969 and 1-year-olds in 1972; shift in spatial-temporal distribution of fishing effort, e.g., since 1970 the fleet has concentrated its effort off Angola during a major part, September and October, of the season; change in availability and/or abundance of skipjack tuna, e.g., 4,400 metric tons or 18 percent of the total 1969 catch and 12,100 metric tons or 50 percent of the total 1972 catch was skipjack tuna; fishermen avoiding the capture of large fish in 1972 because of their high mercury content; or the actual abundance of yellowfin tuna decreased in 1972 within the geographic boundaries where the surface fishery operates.

ACKNOWLEDGMENTS

My sincere thanks to my colleagues W. W. Fox, Jr. and W. H. Lenarz of the Southwest Fisheries Center (SWFC) for their comments on the manuscript and on tuna fisheries in general. To D. Kramer of the SWFC, my appreciation for reading the manuscript and offering pertinent comments. The Inter-American Tropical Tuna Commission provided catch and effort statistics for the American fleet. The cooperation of the captains and owners of American tuna vessels is greatly appreciated and acknowledged.

LITERATURE CITED

Inter-American Tropical Tuna Commission. 1973. Annual report of the Inter-American Tropical Tuna Commission, 1972. [In Engl. and Span.] La Jolla, Calif., 166 p.

Joseph, J. 1970. Management of tropical tunas in the eastern Pacific Ocean. Trans. Am. Fish. Soc. 99:629-648.

Sakagawa, G. T., and W. H. Lenarz. 1972. American participation in tuna fishery of eastern tropical Atlantic. Mar. Fish. Rev. 34(11-12):55-65.

MFR Paper 1040. From Marine Fisheries Review, *Vol. 36, No. 3, March 1974. Copies of this paper, in limited numbers are available from D83, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235.*

MFR PAPER 1041

One of the nation's oldest fishing ports strives to meet the challenges of the '70s.

Diversification Means Progress in the Gloucester Fishing Industry

JON C. RITTGERS

A Gloucester dragger.

INTRODUCTION

In celebrating the city's 350th anniversary in 1973, the people of Gloucester, Mass., honored one of the nation's oldest industries, the commercial fishing industry. Its importance to the economy of Gloucester has been recognized in the past, but is now being jeopardized by a decline in the availability of traditional fish resources and increases in operating costs.

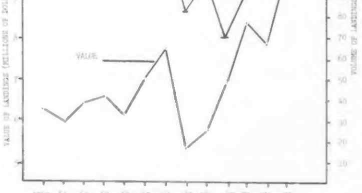


Figure 1.—Volume and value of landings at Gloucester (1960-1972 in millions of dollars and millions of pounds).

As the resource availability has changed over the decade, industry in this port has met the challenge in numerous ways, the most important of which has been its willingness to diversify. Diversification has taken the form of changes in the species composition of the catch and the increased utilization of imported raw fish to supply a large new price-conscious and convenience-minded market for prepared frozen fish products. As a result, a rather large frozen fishery products sector has developed to complement the more traditional fresh fish sector.

LANDINGS

The decade of the 60's saw a continuing decline in landings of fresh fish at the port, falling from the 10-year high of 192 million pounds in 1960 to a low of 69 million pounds in 1969. Since then, the industry has enjoyed three successive years of increased landings and prosperity (Figure 1). Total landings increased 32 percent in 1970 and 1972 landings are estimated to be as much as 62 percent higher than in 1969.

The decline through the 60's was the result of a decline in the landings of whiting and ocean perch—the mainstay of the industry in the early 60's (Figure 2). The darkest year in the decade was experienced in 1967 when the value of landings fell to a low of sightly more than $5 million, down nearly $2.5 million from the previous year (Figure 1). By 1970, landings were valued at over $8 million and by 1972 the value of landings had increased to an estimated record $9.6 million due to increases in prices paid for cod and haddock and increased

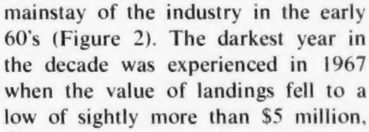


Figure 2.—Volume of whiting and ocean perch landings (1960-1972 in millions of pounds).

Jon C. Rittgers is the Regional Economist for the Northeast Regional Office, National Marine Fisheries Service, State Fish Pier, Gloucester, MA 01930.

Table 1.—Value (in millions of dollars) of Gloucester landings, 1960-72, adjusted for inflation (1967 = 100 percent).

Year	Value adjusted by Consumer Price Index
1960	7.1
1961	6.65
1962	7.1
1963	7.21
1964	6.55
1965	7.45
1966	7.95
1967	5.29
1968	5.499
1969	6.27
1970	7.19
1971	6.42
1972	7.7

Table 2.—Three-year average value of Gloucester landings based on adjusted values in Table 1 (in millions of dollars).

Period	3-Year Average
1960-1962	6.95
1961-1963	6.99
1962-1964	6.95
1963-1965	7.07
1964-1966	7.32
1965-1967	6.90
1966-1968	6.25
1967-1969	5.69
1968-1970	6.32
1969-1971	6.63
1970-1972	7.10

landings of herring, ocean perch, shrimp, and other incidental species. Adjusting the value of landings for inflationary effects, i.e. multiplying actual values by the Consumer Price Index, allows comparison of the industry's relative prosperity over a number of years. This adjustment has been made, using the value of the dollar in 1967 as the base year, and is presented in Table 1. From these data it can be seen that the industry has enjoyed increased prosperity since 1967 and appears to be healthier today than it was a decade ago. An examination of 3-year averages, computed from the values in Table 1, shows that the first 3 years of this decade were in fact better, in terms of value, than the same period of the preceding decade (Table 2).

It is to the credit of the industry in Gloucester that, in the face of declining stocks of traditional species, it has developed new fisheries for such species as herring, shrimp, and offshore lobster (Figures 3 and 4). But, despite the fine performance of the fleet in recovering from the 1967 decline, the real test of its adaptability and willingness to diversify lies in the years immediately ahead. Unless the fleet maintains this capability and willingness to be short-term flexible, the possibility of a decline, such as that experienced in 1967, is always very real. In part, the ability of the fleet to remain flexible depends upon the willingness of the industry to actively seek or develop markets for abundant species product forms to supplement products of the more traditional species.

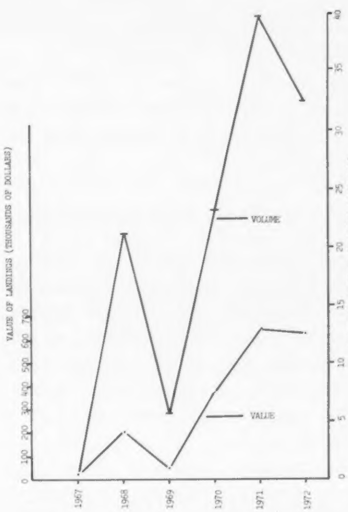


Figure 3.—Volume and value of herring landings in Gloucester, 1967 through 1972 (millions of pounds and thousands of dollars).

Monofilament gill nets are used in the mackerel fishery out of Gloucester.

PROCESSING

In 1970, 130 million pounds of fishery products, valued at nearly $65 million, were processed in Gloucester.

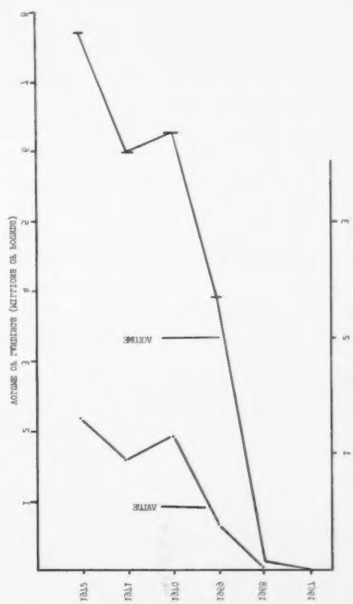


Figure 4.—Volume and value of shrimp landings in Gloucester, 1967-1972 (millions of pounds and millions of dollars).

Imported frozen fish blocks being moved into cold storage facilities located in Gloucester. The port is a major cold storage center on the east coast with about 85 million pounds of capacity.

This represented a 160 percent increase over the 1960 value of production. Nearly 73 percent of this production was in the form of fish sticks, portions, and fillets.

Fish Sticks and Portions

Total U.S. production of fish sticks and portions tripled during the decade while production in Gloucester doubled. As a result, Gloucester plants contributed about 18.5 percent to total U.S. output in 1970 compared to its 1960 contribution of 26.2 percent. The industry's production record is summarized in Table 3 for 1960 and 1970.

Table 3.—U.S. and Gloucester production of fish sticks and portions, 1960 and 1970 (in thousands of pounds and dollars)[1].

	U.S.		Gloucester		Gloucester as a percent of U.S.	
Year	Volume	Value	Volume	Value[2]	Percent of Volume	Percent of Value
1960	114,500	$ 46,188	30,000	$12,700	26.2	27.5
1970	349,373	$155,290	64,799	$29,526	18.5	19.0
Percent Change	+206	+237	+116	+132.5		

[1] Source: Current Fishery Statistics, Fisheries of the U.S., NMFS, NOAA, Department of Commerce.
[2] Value to the processor, FOB Gloucester.

Steaks and Fillets

Total U.S. production of steaks and fillets declined during the decade from 153.2 million pounds valued at $48.4 million in 1960 to 133.5 million pounds valued at $74.8 million in 1970.

Interestingly, Gloucester's production of steaks and fillets did not follow the U.S. trend. Production in 1960 was 25.2 million pounds, with a value to the processor of $5.7 million, compared to 30.6 million pounds valued at $14.8 million in 1970. The 1970 production in Gloucester represented a 21 percent gain in volume and 160 percent increase in value over the 1960 production of steaks and fillets. As a result, Gloucester's share of the total U.S. output of these products rose from 16.5 percent in 1960 to 23 percent in 1970 and in terms of value from 11.8 percent in 1960 to 19.6 percent in 1970. The industry's production record for steaks and fillets is summarized in Table 4.

Table 4.—U.S. and Gloucester production of steaks and fillets, 1960 and 1970 (in thousands of pounds and dollars)[1].

	U.S.		Gloucester		Gloucester as a percent of U.S.	
Year	Volume	Value	Volume	Value[2]	Percent of Volume	Percent of Value
1960	153,200	$48,400	25,200	$ 5,700	16.5	11.8
1970	133,809	$75,430	30,616	$14,813	23.0	19.6
Percent Change	−12.7	+55.8	+21.5	+160		

[1] Source: Current Fishery Statistics, Fisheries of the U.S., NMFS, NOAA, Department of Commerce.
[2] Value to the processor, FOB Gloucester.

EMPLOYMENT AND EARNINGS

Although the industry's output record is impressive, it has little direct meaning to the average citizen. The importance of the industry to the community can be demonstrated by looking briefly at the record of employment and earnings generated by the industry.

Information available from the Massachusetts Division of Employment Security shows that in 1971 there were 94 Gloucester fishing vessels that made payments to the State to cover their employees under the unemployment insurance program.[1] These Gloucester fishing vessels paid the insurance cost for 648 fishermen in 1971. It is also estimated that there are about 100 other Gloucester men self-employed full-time on other craft[2]. Thus, total full-time fishing employment was nearly 750 men in 1971. This represents 5.7 percent of the total work force of 13,250 persons in Gloucester in 1971 compared to 12 percent in 1960 when a total of 1,211 persons[3] were engaged full-time in fishing.

This decline in employment in fishing has been offset to some degree by an increase in the manufacturing and allied industries sector. Information provided by the Gloucester Fisheries Commission as a result of a survey of firms shows that total employment of plant workers and stevedores in 1972 had reached a level of about 2,000. This, when added to

[1]NMFS does not keep official statistical data on vessels by "home port." Thus, since employers are required to pay into the Employment Security System for employees hired for 13 or more weeks in any one calendar year, this appears to be the most reliable source for employment data.
[2]Gloucester Fisheries Commission.
[3]Zellen, Michael S. "Port of Gloucester Sets Example of Bootstrap Pulling," *Fishing Gazette*, Sept. 1972.

Part of the small-boat fleet tied up at a pier in Gloucester.

Unloading cod at a Gloucester fresh fish processing plant.

the number of fishermen, brings total direct fishing industry employment to nearly 2,800 or approximately 21 percent of the total work force in the city in 1972.

Earnings of most fishermen are based on a share of the landed value of fish. An analysis of the Boston large trawler fleet suggested that about 40 percent of the value of catch goes to fishermen as net earnings.[4] On this basis, then, it is estimated that in 1972 there were about $4.5 million[5] in crew earnings in Gloucester compared to about $2.7 million[6] annual crew earnings in 1960. This, along with the 648 men covered by the Employment Security program in 1971,[7] indicates that the average annual earnings by these Gloucester fishermen were nearly $7,000 for 1972 compared to $3,000 in 1960.[8] This compares favorably with the Employment Security data available on these 648 fishermen, which reports their reported average annual wage credits as being $7,235 for 1971. There is, however, a wide range in individual earnings. A 1973 sample survey of Gloucester fishermen Employment Security claimants showed a $381 difference in the average weekly earnings of claimants in the first quarter of 1973.[9]

Although available data reveal little with regard to earnings in the allied industries of Gloucester, it is possible to make some rough estimates. According to data available from NMFS, in 1972 nearly 400 million pounds[10] of imported fishery products were handled by the two stevedoring groups in Gloucester at an estimated total charge of over $1 million.

Although exact data are not available on the earnings of plant workers, the employment information provided by the Gloucester Fisheries Commission and union hourly wage rates suggest that total earnings to plant managers and workers employed in firms processing imported and domestic products would be between $15 million and $16 million in 1972. This, added to the earnings by fishermen, brings the total direct earnings to labor in the fishing industry to over $20 million in 1972. If accurate estimates on return to capital investments were available for the industry, total earnings to both labor and capital would be considerably greater than the $20 million return to labor estimated above.

Overall, it is estimated that an equal amount of economic activity is being generated in the community by those firms providing a domestically produced product and those providing an imported product for American consumption.

A CHALLENGE FOR THE FUTURE

In the face of adverse resource conditions and inflationary pressures, the industry in Gloucester has managed to make adjustments which resulted in an economically improved condition in 1972, relative to 1960. Undoubtedly this industry will face additional and perhaps even more difficult problems in the decade of the 70's. However, its demonstrated resiliency and adaptability are encouraging signs. Unemployment continues to be a persistent problem in Gloucester due primarily to a shortage of employment opportunities outside the fishing industry. Thus, the importance of both the domestic and import product fishery sectors in Gloucester looms even larger than the apparent importance of the number of jobs provided. The community will do well to support all segments of this industry in its efforts to modernize and become economically more efficient through the 70's. To do otherwise would level a disastrous blow to the economy and the people of Gloucester.

[4]Noetzel, B. G. and Norton, V. J. "Cost and Earnings in the Boston Large Trawler Fleet," Working Paper No. 7, Bureau of Commercial Fisheries, Division of Economic Research, June 1969.
[5]Includes estimated value of landings by Gloucester boats in other ports.
[6]Zellen, op. cit.
[7]1971 employment is used as a best estimate for 1972.
[8]Zellen, op. cit.
[9]Personal conversation with officials of the Massachusetts Division of Employment Security. The sample ranged from a low of $77 to $458 per week and cannot be considered an estimate of the annual range but only a reflection of the variability in fishermen earnings. Such survey data was not available for previous years.
[10]This includes fresh sea herring.

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MFR PAPER 1042

The 49th state offers many rewards to the marine angler.

Marine Recreational Fishing in Alaska

This paper on marine sport fishing in Alaska was written by staff members of the Alaska Region, National Marine Fisheries Service, Juneau, AK 99801.

INTRODUCTION

Alaskans go fishing. Marine sport fishing in Alaska occurs primarily near centers of population and along coastal road systems. In southeastern Alaska many anglers can be on the fishing grounds within an hour from the time they leave work in the afternoon. In 1969 for example, Kodiak sportsmen took over 12,000 pink salmon while surf fishing at the mouth of the Buskin River, a 20-minute drive from town.

Elsewhere saltwater fishing may prove a major weekend undertaking. Some residents of the greater Anchorage area may actually keep their pleasure boats in such places as Homer or Seward for the entire summer, commuting on the weekend to fish. Many Canadian residents use cartop skiffs or trailer small boats from as far away as Whitehorse, Yukon Territory to Haines for a weekend's fishing. All indications point to a continued rapid increase in marine recreational fishing in Alaska. Both resident and nonresident sport fishing license sales dramatically support this contention.

SPORT FISHING LICENSE SALES

Resident license sales have increased from 33,300 in 1960 to 71,707 in 1970, a gain of 116 percent in 10 years. In 1970 over 37 percent of all Alaskans 16 years and older bought sport fishing licenses. Many others under 16 years of age, and who are not required to purchase fishing licenses, fished too.

The sale of nonresident sport fishing licenses shows even greater growth. In 1960 nonresidents purchased 12,800 fishing licenses while in 1970 sales reached 41,683, an increase of 226 percent in just 10 years. Revenues from nonresident license sales comprised only 38 percent of total sales in 1960 but by 1970, 50 percent of the license revenues came from nonresident sources. We believe this rapid increase in nonresident sport fishing will continue.

Several factors contribute to the expanded interest in sport fishing in Alaskan waters. The State of Alaska is increasing its ferry system throughout southeastern Alaska and more people are using the marine highway each year. Air travel from Seattle has made major centers along Alaska's coastline readily accessible to tourists from the lower 48 states. A sportsman can now board a plane in Seattle and be in Juneau in just 2 hours. An additional 1½-hours flying time puts an angler in Anchorage, which is centrally located with good transportation for reaching prime fishing areas on the Kenai and Alaska Peninsulas. Visitors are journeying to Alaska in increasing numbers each year. Many of these people are anglers and they are quick to learn that catching a 12-14 pound coho or 30-40 pound chinook salmon provides a high quality fishing experience.

MARINE SPORT FISHING VALUE

In 1970, resident and nonresident sport fishermen purchased Alaskan licenses worth $662,081. The 1970 National Fishing and Hunting Survey, compiled for the U.S. Bureau of Sport Fisheries and Wildlife, estimated that the average freshwater fisherman spent $127 per year while the average saltwater angler spent $129 per year. Recognizing that these values are undoubtedly low for Alaskans, we can still use them to estimate that resident Alaskans spent a minimum of $9,250,203 to go sport fishing in 1970. Since approximately 75 percent of Alaskans live on or near the coast, we may assume that at least about the same proportion of license holders fish for marine or anadromous fish species, primarily salmon. Consequently, marine sport fishing in Alaska represented a minimum expenditure of over $6.9 million in 1970.

Although most anglers direct their attention toward salmon fishing (primarily chinook and cohos) a growing number of fishermen are becoming aware of other anadromous species that provide excellent fishing at certain times and locations throughout

Fishing derbys are popular in Alaska. Here, boats take off at one of the three starting lines during the 1973 Golden North Salmon Derby[1] at Juneau.

Alaska. Steelhead trout, cutthroat trout, Arctic char, Dolly Varden char, and shee fish all offer exciting recreation to the angler willing to spend a little extra time and effort to seek them. Other visitors are delighted when they catch a Pacific halibut or a few crabs or dig a bucket of razor clams.

While current interest centers on the above species, a high abundance of other marine fishes provides an unequaled opportunity for the informed angler. Potential sport fisheries also exist for true cod, ling cod, rockfishes, greenlings, and other flat fishes that are all now being considered scrap fish by most fishermen. Herein lies a real potential for developing an expanded sport fishery through educating the fishing public to the value of these species as welcomed additions to the angler's creel.

Currently, from 90 to 95 percent of the marine recreational fishing is probably directed toward chinook and coho salmon. The Alaska Department of Fish and Game, fully recognizing the importance of marine recreational fishing, conducts a fairly substantial marine sport fish program supported largely by Dingell-Johnson funds. The program covers four major areas of endeavor: creel census, hatchery propagation, pond and lake culture, and escapement surveys.

[1]Mention of trade names or commercial products in this publication does not imply endorsement by the National Marine Fisheries Service, NOAA.

NMFS SALMON STUDIES

Although the NMFS now funds no projects solely for the marine recreational fishery in Alaska, considerable progress is being made in certain research that will produce spin-off benefits for sport fishing. Perhaps the most significant program having such potential is the salmon enhancement work being done at our Little Port Walter field station and the Auke Bay Fisheries Laboratory. Here, scientists are developing gravel incubation and rearing techniques that may markedly increase the production of salmon per unit area with only modest outlays of funds and effort. At Little Port Walter, pilot experiments on saltwater rearing of coho smolts with supplemental feedings are producing very encouraging results. A similar experiment is being carried out with chinook. Correlative experiments of planting coho in virgin lakes, not utilized because of barrier falls, are also yielding promising results. Fry are reared in these lakes without supplemental feeding, thus providing low-cost seaward migrants. Overall returns from the various experiments (saltwater pen rearing, virgin lake plants, and different stocking densities) stand at about 16 percent. The U.S. Forest Service and the Alaska Department of Fish and Game have endorsed this research and are joining NMFS in a production-scale project to evaluate the smolt-producing potential of four lakes near Little Port Walter having a combined area of about 740 acres. In addition to this project, Little Port Walter is serving as a source of coho eggs for the ADF&G hatchery program.

Gaining knowledge of the behavior and life history of potentially important sport fish species prior to exploitation can provide resource managers with valuable information upon which to base realistic management programs. Scientists at Auke Bay have completed studies that show the existence of a home site and homing ability for adult yellowtail rockfish. Rockfish are potentially excellent sport fish on light tackle, but this study shows that intensive fishing of a localized adult stock could cause a long-term decline in its abundance, an important consideration in managing this species for a sport fishery.

IMPORTANT USE OF BAYS AND ESTUARIES

The Water Resource Studies Division of the NMFS recognizes marine sport fishing as an important use of Alaska's bays and estuaries. Serious consideration is given to this use of natural resources in their review of

the impact of proposed projects on marine, estuarine, and anadromous fishes and their environments. This Division also works closely with the Corps of Engineers, U.S. Forest Service, and other governmental agencies to insure that adequate measures are taken during the planning and construction of projects to protect and enhance marine sport fishing opportunities.

Currently, a feasibility study initiated by WRS personnel is being proposed for the Corps of Engineers Chena River Flood Control Project near Fairbanks. If adopted, this project would utilize gravel incubation techniques to enhance the chinook salmon runs to this river, providing a source of eggs for the State to use in improving runs to other areas, as well as augmenting an already existing sport fishery for this species deep in interior Alaska.

The outlook for marine recreational fishing in Alaska is not all bright. Already some potentially serious problems are developing whose resolutions will require considerable effort on the part of biologists, resource managers, legislators, and the general public. Chief among these is the localized, but intense, conflict between sport and commercial fishermen. Antagonism has already developed in such areas as Seward, upper Cook Inlet, and certain sections of Prince William Sound and southeastern Alaska. Devising systems for the fair allocation of fishery resources between various users will require additional time and effort as sport fishing pressure increases for such species as chinook, coho, and sockeye salmon.

Conflicts may also arise regarding the origin of these two species. An unknown proportion of chinook and coho salmon orginate in Canadian spawning grounds. Some chinooks from the Panhandle rivers of southeastern Alaska come from spawning grounds that are principally in Canada, but pass through Alaskan rivers and estuaries on their seaward migration and returning spawning runs. In our negotiations with Canada then, we must eventually come to grips with weighing the value of a spawning ground as compared to the rearing areas and migration paths of the estuaries.

Even small skiffs can offer exciting salmon fishing potential in the sheltered inside waters of Southeastern Alaska. Alaska Department of Fish and Game photo.

Other problems confronting managers center around the collection of data and educating the public regarding the yet untapped sport fishing potential of other marine species. Creel census data collection must be standardized, expanded, and used to support additional research. Educational programs to expand public interest in other fishes with sport potential will take some pressure off diminished salmon runs until enhancement measures can be initiated to build up stocks now under intensive exploitation by both sport and commercial fishermen. Further, research on paralytic shellfish poisoning might result in dramatically expanding both the sport and commercial fishery for bivalves, particularly the butter clam, in southeastern Alaska, if a sure and simple method for determining clam toxicity can be developed.

Despite these problems, the future looks bright for Alaska's growing marine recreational fishery. The increasing pressure on sport fish resources around population centers can be met with aggressive and imaginative research and management programs. Conflicts in resource allocation can be solved through the development of fair regulations based on sound research programs.

The NMFS's role in developing Alaska's marine recreational fisheries will center on (1) providing active support to the State of Alaska for the collection, compilation, and publication of marine sport fish creel census data; (2) continuing the development and improvement of enhancement measures using gravel incubators, saltwater rearing pens, virgin lakes for rearing coho and chinook fry; (3) conducting an informational and educational program directed toward developing public interest in recreational fishing for rockfish, soles, and cods presently regarded as scrap fish; (4) supporting an economic study of the impact of marine recreational fishing on Alaskan communities, and (5) working with the State of Alaska through the State/Federal Program to develop management programs providing fair allocation of catches between users.

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Composition of the Edible Portion of Raw (Fresh or Frozen) Crustaceans, Finfish, and Mollusks. I. Protein, Fat, Moisture, Ash, Carbohydrate, Energy Value, and Cholesterol

VIRGINIA D. SIDWELL, PAULINE R. FONCANNON, NANCY S. MOORE, AND JAMES C. BONNET

ABSTRACT

This report summarizes the data on protein, fat, moisture, ash, carbohydrate, energy (calories) and cholesterol from 155 references on 154 commonly eaten fish flesh.

INTRODUCTION

Considerable data have been published on many aspects of the chemical and nutritional values of fish and fishery products, but at no time have appreciable amounts of these data been assembled in a tabular form. If the data were so assembled and characterized, then industry, medical services, and the general public would have a good reliable source of information on the composition of fish. For example, industry will need these data for putting nutritional information on labels of canned fish or fishery products. Today, doctors and dietitians are especially interested in the content of the various lipid materials in foods since these fat-like substances of an individual's diet may be involved in the degeneration of the vascular system. There are indications that certain highly unsaturated fatty components in fish may be beneficial in the treatment of the disorder. In order to recommend the inclusion of fish in the patient's diet, however, the doctor must know not only the fat content but also the fatty acid composition including degree of unsaturation, and the amount of steroid material, like cholesterol.

The best compilation on the nutritive composition of foods in general is the U.S. Department of Agriculture, Handbook 8, *Composition of Foods* by B. K. Watts and A. L. Merrill. For fish and fishery products, however, the data are limited, particularly for minerals and vitamins.

This paper is an interim report on protein, fat, moisture, ash, carbohydrate, energy value, and cholesterol. Other interim reports will deal with the vitamins, minerals, fatty acids, and amino acids. The need for these data is so urgent that we prefer not to wait until the review of literature is completed.

Our primary objectives are: (1) to develop a comprehensive data bank on the chemical and nutritional composition of fish and fishery products; (2) to publish, as completely as possible, information on the nutrients found in fishery products; and (3) to point out areas in the chemical composition of fish needing further investigations.

At first we planned to review only the literature reporting the work done in the western hemisphere. Subsequently, we decided to enlarge our scope into a review of literature published anywhere in the world, because over 60 percent of the fishery products eaten by the Americans are imported from many nations throughout the world.

The title of the article reviewed, name of the author, and publication were obtained from bibliographies or abstracts. Copies of the original article were obtained from the National Agricultural Library, U.S. Department of Agriculture; the National Library of Medicine, U.S. Department of Health, Education and Welfare; the Natural Resources Library, U.S. Department of the Interior; or from universities and other research libraries.

No data are put in the bank unless we have a copy of the original article on file. The data in each article are carefully scrutinized before they are transcribed onto the appropriate sheets. There is a sheet for each of the following: proximates, vitamins, minerals, fatty acids, and amino acids. At this time, if necessary, the values are recalculated into the units set up in the guidelines, i.e. milligrams per 100

Virginia D. Sidwell, Pauline R. Foncannon, Nancy S. Moore, and James C. Bonnet are members of the staff of the College Park Fishery Products Technology Laboratory, National Marine Fisheries Service, NOAA, College Park, MD 20740.

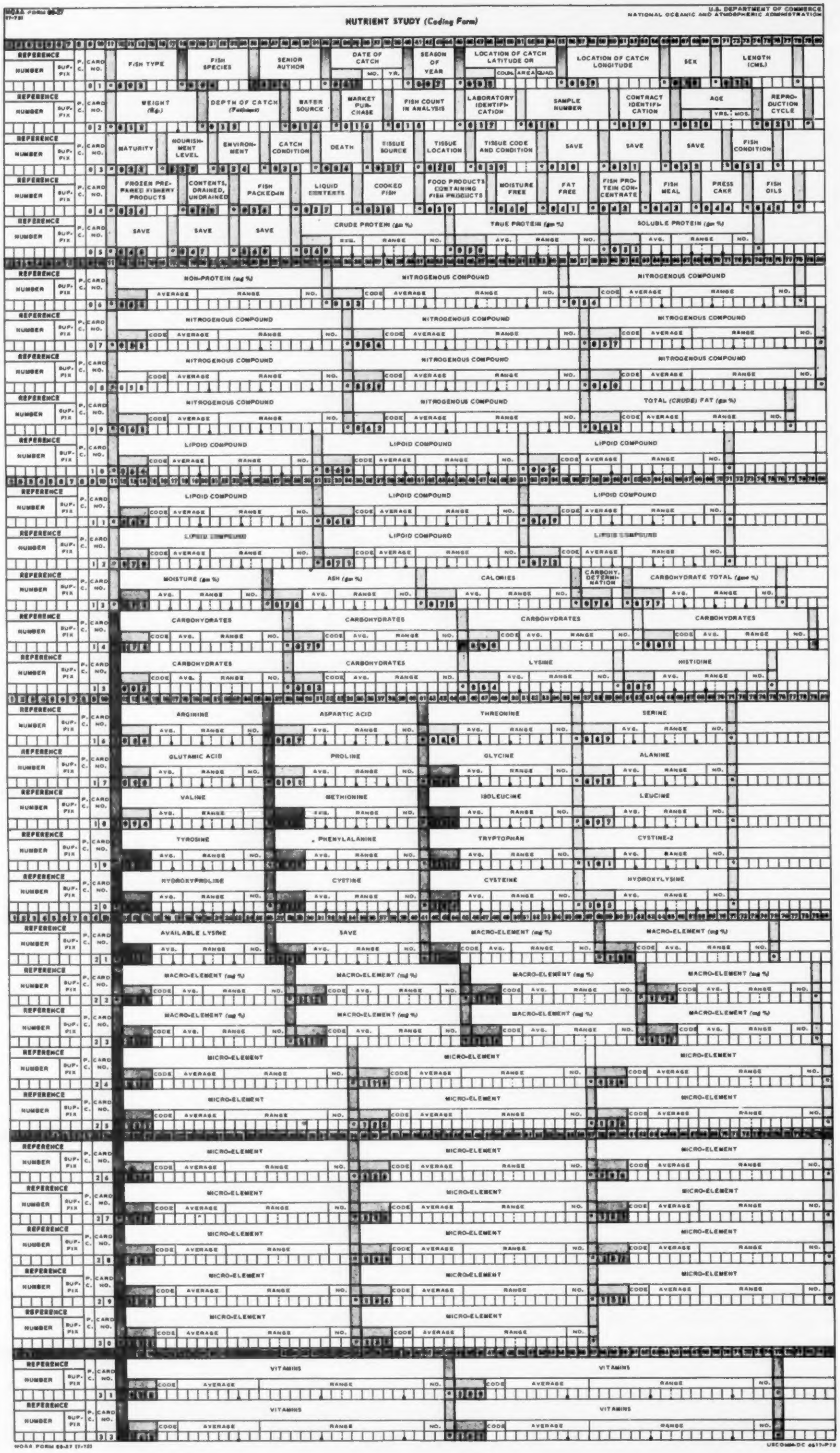
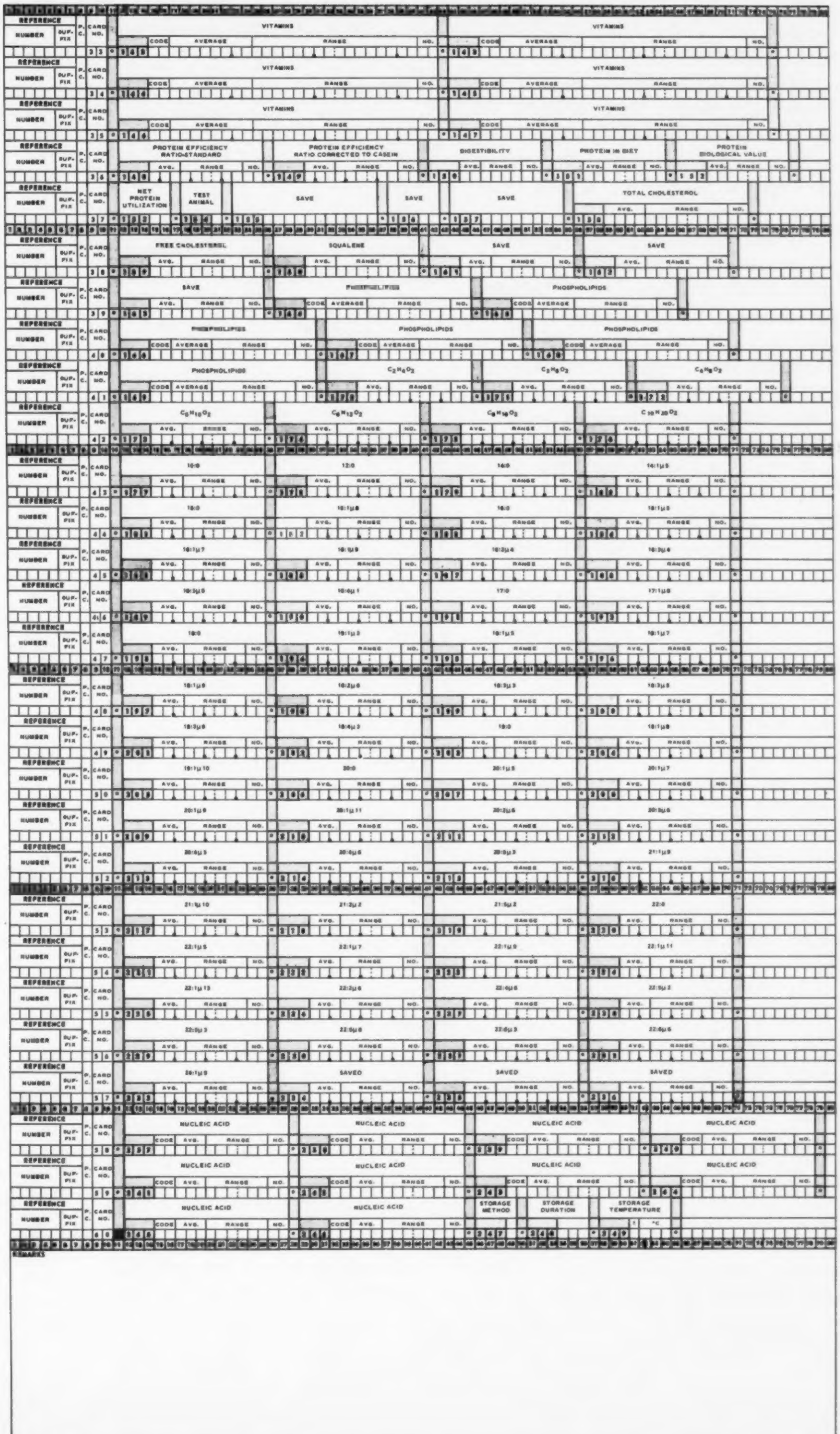


Figure 1. — Page 1 of the Coding Form.

Figure 2. — Page 2 of the coding form.



grams, instead of milligrams per kilogram of fish.

After several conferences with the computer system's programmer, we decided on the coding form pictured in Figures 1 and 2, listing all possible information needed for a data bank on the composition of fish.

At the time the program was written, no systematic coding of the fish or shellfish was available, so we decided to list the fish family by common names in alphabetic order and give each family a number ranging from 001 to a possible 999. Under each family we listed the species by common and scientific names again with numbers 001 to a possible 989. The numbers 990 to 999 were saved for any fish classified by the investigator by the common name with no specific scientific name mentioned. This system is expandable. We were not always able to keep the common names in alphabetical order. A number is assigned to each family and species as they appear in our review of the literature. So far we have found a number of other families of fish or shellfish that were not in the first listing. Consequently, we sacrificed the alphabetical order and continued with the numerical system.

The first three cards record the history of the fish or fishery product used in the analyses. Card one and all the cards used to record the data on a particular fish will carry the identification-reference number and suffix. The reference number is assigned to the publication when it is reviewed and recorded for the data bank. To the reference number a suffix number is attached for each species of fish reported in the publication. Therefore, this system will make each record on each fish unique. The data on the magnetic tape will be in chronological order by reference number and suffix number, for example:

Reference No.	Suffix
00012	01 for Atlantic cod
	02 for bluefin tuna
	03 for anchovy
00013	01 for mackerel
	02 for shrimp
	03 etc.

The fish family (fish type) number and species number will identify the fish, for example:

Reference No.	Suffix No.	Card No.	Family No.	Species No.
00012	01	01	033	008
00012	02	01	091	023

That series of figures shows that in Reference 12 there is an analysis on Atlantic cod. In that same reference, there is also an analysis on bluefin tuna. Also card number 1 records the date, season, and location of catch, and sex and size of the fish or shellfish.

The second card presents information on the environment, saltwater or freshwater, number of fish involved in the study, age, physiological status, and tissue used in the analyses.

The third card describes the process the fishery product has undergone, for example cooked, canned, extracted for fish meal, fishery product added to another product, as in soups.

Theoretically, if all possible information could be obtained on one batch of fish, it would take 60 cards to record all the data. Chances for this to happen are small, in fact almost nil. The scientist is usually interested in one or several aspects of the composition of fish, so he will make the same determinations on a number of fish. The number of entries depends upon what the investigator studied. For example, if the scientist has done only protein, moisture, fat, and ash analyses, there will be four entries on each fish. Another scientist worked on fatty acid composition of fish, whereby there will be 62 entries for each fish.

After the data have been recorded on the coding sheet (Figures 1 and 2), the procedure is:

1. Cards are punched from coding sheet.
2. Cards are sorted and placed in numerical order by reference number and suffix number.

00012	01
	02
	03 etc.
00013	01
	02
	03 etc.

3. The data on the cards are printed, so these data can be easily checked against the coding sheet to catch punching errors.
4. The corrected "deck of cards" is edited for mechanical errors. For example, an asterisk has been left out, or placed in the wrong space, consequently the machine will not take the card.
5. As soon as the cards are acceptable to the machine, the data are put on magnetic tape for storage. At this time there is a printout of the data that were put on the tape.
6. Again the data are checked, this time against the original publication.
7. If, by chance, there is an error, a new card is punched with a special code number 1 in the space between the suffix number and card number. This automatically erases the data on the tape and replaces the new data from the correction card.

As may be noted, there are a number of checkpoints, so the final record will be as correct as is humanly possible. Since so many people are involved in the process of putting the data on the tape, checking the data at various points becomes an important factor.

DISCUSSION

So far, in our literature search we have located 155 articles containing suitable data for protein, fat, moisture, ash, carbohydrate, energy, and cholesterol values for 154 species of fish commonly eaten throughout the world.

Each investigator reported an average figure obtained either from several determinations on a composite of fish, or from a determination on each of a number of fish. In the latter instance, the scientist reported the average and the range of the results obtained from the analyses. These averages were used to calculate the overall average and the standard error of the mean.

The variability in fat and moisture content is due mainly to the natural season variation, but also age, size, and type of fish play an important role. The

Table 1.—Composition of the edible portion of raw (fresh or frozen) Crustacea, finfish and mollusks. I. Protein, fat, moisture, ash, carbohydrate, energy, and cholesterol.

	Protein	Fat	Moisture	Ash	Carbohydrate	Energy	Cholesterol	References
			gm per 100 gm			cal/100 gm	mg/100 gm	
Abalone *Haliotis kamtschatkana*	[1]14.9±0.2 [2]10.4—18.2 [3]4	[1]0.5±0.1 [2]0.3—0.7 [3]3	[1]76.9±2.9 [2]72.6—82.4 [3]3	[1]1.8±0.6 [2]1.0—3.0 [3]3				10, 65, 76, 122
Albacore *Thunnus alalunga*	24.2±0.5 19.1—27.6 18	5.4±0.9 0.7—18.2 19	70.2±1.0 62.3—78.6 17	1.3±0.1 1.2—2.4 18	[1]0.2 [3]1	[1]134±17 [2]107—185 [3]5		10, 43, 68, 70, 102, 108, 133, 143
Amberjacks *Seriola* spp.	21.1±0.7 20.1—22.5 3	1.6±0.4 0.8—3.1 5	75.2±1.2 73.4—77.5 3	1.2 1.1—1.3 2		96 1		61, 65, 106, 144
Anchovies *Engraulidae* spp	20.2±0.7 18.4—21.8 4	2.4±0.8 0.5—3.8 4	76.0±1.1 73.4—81.0 4	1.8±0.1 1.5—2.1 4		93±5.3 73—103 3		3, 5, 11, 65, 68, 108, 121, 143
Anchovy, striped *Anchoa hepsetus*	17.4±0.2 16.2—18.9 21	2.8±0.2 1.6—4.6 21	76.6±0.3 74.2—78.1 21	3.3±0.1 2.6—4.1 21				80, 128, 129, 130, 132
Barracouta *Thyrsites atun*	22.0±0.1 21.9—22.1 3	4.8±1.2 2.6—6.7 3	71.0±0.9 69.5—72.6 3	1.6±0.2 1.3—1.8 3	0.7 1	132 1		68, 144
Barracudas *Sphyraenidae* spp	19.8±0.2 18.4—22.1 39	3.2±0.4 0.2—10.3 43	75.8±0.4 69.1—79.5 40	1.7±0.1 1.1—2.5 40	1.1±0.3 0.1—2.2 6	94±3.1 77—110 9		5, 9, 11, 60, 62, 65, 67, 121, 143
Basses *Percichthyidae* spp	18.1±0.3 16.6—18.9 11	3.0±0.6 0.1—6.7 9	77.4±0.7 74.5—81.1 11	1.4±0.2 1.0—2.9 11		113±11.0 92—129 3		11, 14, 45, 54, 95, 102, 140, 144
Basses *Serranidae* spp	18.6±0.3 17.3—20.1 7	1.6±0.4 .1—3.0 7	78.6±0.3 77.3—79.6 7	1.1±0.1 0.9—1.2 7				14, 54, 80, 95
Bluefishes *Pomatomidae* spp	21.0±0.4 20.4—21.6 3	3.8±0.8 2.1—4.8 3	74.7±1.7 69.0—81.4 6	1.3±0.1 1.1—1.5 4				14, 15, 16, 84, 151
Bonita *Sarda* spp	24.7±1.6 22.6—29.3 4	4.5±2.0 1.5—10.2 4	71.3±1.9 66.3—74.8 4	1.5±0.1 1.4—1.7 4				11, 14, 43, 144
Bream *Pagellus* spp	17.9±1.0 16.4—20.7 4	1.6±0.4 0.5—2.3 5	74.8±3.5 61.3—80.2 5	1.5±0.4 1.4—1.6 5		82.3±4.6 70—92 4		102, 144
Bream, lg-eyed *Monotaxes grandoculis*	18.4±0.6 17.1—19.0 3	1.0±0.4 0.6—1.8 3	78.2±0.6 77.0—79.2 3	1.2±0.2 0.8—1.4 3	1.6 1	90.5 89—92 2		65, 121
Burbot *Lota lota*	18.0±0.7 16.8—19.2 3	0.8±0.2 0.6—1.2 3	80.3±0.2 80.1—80.6 3	1.3±0.3 1.0—1.9 3				45, 140
Butterfishes *Stromateidae* spp	17.7±0.4 15.0—20.7 13	7.2±1.9 0.9—24.5 13	74.3±1.7 56.5—80.4 13	1.4±0.4 0.9—2.5 13	1.3±0.6 0.3—2.6 4	95 95—95 2		1, 5, 6, 10, 14, 16, 65, 95, 108, 118, 121, 143
Carp *Barbus* spp	20.6 16.0—25.2 2	2.7 2.3—3.1 2	74.7 70.3—79.1 2	1.4 1.2—1.5 2				101, 105
Carp *Cirrhina mrigala*	18.9±0.2 18.1—19.6 10	0.9±0.5 0.2—4.0 8	78.0±0.4 75.0—79.8 10	1.4±2.1 1.0—1.6 8	1.4±0.2 0.6—2.0 7	86.7±0.9 84.0—90.0 7		100, 104
Carp *Cyrpinus carpio*	18.0±0.2 17.4—19.3 9	6.2±1.2 3.3—14.8 9	75.6±1.1 66.2—79.8 14	1.1±0.03 1.0—1.2 7				10, 22, 27, 45, 73, 115, 140
Carp, Indian *Labeo* spp	16.8±0.4 14.3—19.1 12	4.6±2.9 0.5—24.5 8	79.7±0.8 72.5—82.1 12	1.3±0.1 0.9—1.4 8	0.4±0.1 0.3—0.4 2			1, 100, 101, 104, 105
Catfishes, air-breathing *Clariidae* spp	17.3±0.8 15.0—19.7 5	2.5±1.0 0.4—4.8 5	77.6±0.7 76.3—79.9 5	1.4±0.2 1.1—2.1 5	0.2 0.1—0.3 2	103±12.7 78—117 3		5, 65, 104, 108, 121

Table 1, continued.

	Protein	Fat	Moisture	Ash	Carbohydrate	Energy	Cholesterol	References
			gm per 100 gm			*cal/100 gm*	*mg/100 gm*	
Catfishes, freshwater *Ictaluridae* spp	17.6±0.8 15.4—22.8 10	3.2±1.8 0.3—11.0 10	77.8±1.2 68.0—82.6 14	1.1±0.1 0.9—1.7 10				24, 25, 34, 45, 72, 84, 91, 101, 104, 115, 140
Catfishes, sea *Ariidae* spp	18.3±0.9 12.7—21.2 9	1.2±0.3 0.2—2.9 8	78.3±0.6 75.1—81.1 9	1.3±0.1 0.9—1.6 9	0.5±0.1 0.4—0.6 3	84.2±3.0 74—90 5		5, 65, 108, 112, 121, 143
Chubs, sea *Kyphosidae* spp	21.1 1	4.2 2.0—6.3 2	76.0 75.9—76.0 2	1.3 1.1—1.4 2		102 1		16, 62, 121
Chubs, Utah *Gila atraria*	15.5 1	4.8 1	79.3 1	1.0 1				140
Cisco, longjaw, trout *Coregonus alpenae*	15.5±0.8 13.3—16.9 4	12.5±3.1 7.6—21.5 4	71.2±2.8 63.8—77.2 4	1.5±0.4 1.0—2.7 4				140
Clam Miscellaneous spp	11.7±0.4 7.6—19.0 21	1.4±0.2 0.3—4.8 19	83.0±0.7 73.7—87.9 16	1.8±0.2 0.8—3.9 11				10, 65, 74, 122, 123, 131, 143, 146
Clam, short neck *Venerupis semi decusata*	12.8±0.2 12.2—13.6 5	0.8±0.04 0.7—0.9 5	84.9 1					4, 123
Clam, soft shell *Mya arenaria*	11.2±0.06 9.7—15.6 10	2.0 1.4—2.5 2	84.8±1.0 78.5—87.8 8	1.7 1	1.7 1	89 1		7, 10, 63, 99
Cod, Atlantic *Gadus morhua*	17.9±0.4 16.5—20.7 9	0.3±0.1 0.1—0.8 8	81.1±0.4 78.2—82.6 10	1.1±0.3 1.0—1.2 7				10, 35, 83, 118, 125, 151
Cods *Gadus* spp	18.8±0.7 17.7—21.4 5	0.5±0.2 0.1—1.0 5	79.2±1.0 75.5—81.4 5	1.5±0.2 1.1—2.1 5		86.0±5.6 79.0—97.0 3		14, 35, 102
Congers, pike *Muraenesocidae* spp	18.4±0.7 16.9—21.5 6	0.9±0.2 0.2—1.5 5	78.9±0.6 77.3—80.3 6	1.3±0.2 0.6—2.0 6	0.8 1	85±4.0 80—93 3		5, 65, 75, 108, 112, 121
Crab Miscellaneous spp	15.8±1.4 7.2—22.4 10	3.1±1.3 0.1—12.5 9	76.1±1.8 61.0—84.7 12	2.5±0.5 1.4—6.2 9				34, 56, 58, 94, 96, 108, 143
Crab, blue *Callinectes sapidus*	16.1±0.5 11.9—19.2 18	1.0±0.1 0.4—1.5 18	81.2±0.6 77.4—86.7 17	1.6±0.1 1.3—1.8 15	1.25 0.5—2.0 2	81.5 77—86 2	84 70—98 2	10, 47, 126, 131, 149
Crab, Dungeness *Cancer magister*	17.2±0.7 14.3—23.4 12	1.4±0.1 0.7—2.2 14	80.5±0.3 78.5—82.3 13	1.4±0.1 1.2—1.9 11		85±4.6 77—97 4	57.5 52—63 2	10, 48, 49
Crab, deep sea *Neptunnis* spp	16.5±0.5 12.8—18.8 12	0.5 1	78.4±0.6 75.9—81.4 12	1.45 0.6—2.3 2	0.3 1			51, 52
Crab, king *Paralithodes camtschatica*	17.2±0.7 14.6—19.0 7	0.7±0.2 0.2—1.4 6	80.7±0.6 80.1—82.8 6	1.6±0.2 1.3—2.2 5				10, 92, 124
Crab, samaon *Scylla serrata*	14.9±0.4 11.8—20.1 22	2.9±1.1 0.7—4.0 3	80.3±0.5 75.1—83.9 22	1.8±0.1 1.5—1.9 4	0.6 1			51, 52, 65, 112
Crayfish Miscellaneous spp	18.7±0.9 17.0—19.6 3	1.7 1	76.3±0.2 72.4—80.1 3	1.1 1				36, 65, 112
Croakers *Sciaenidae* spp	19.0±1.4 14.1—29.1 9	1.9±0.4 0.4—4.9 10	78.5±1.1 72.0 9	1.3±0.1 0.9—1.8 9		103 1		5, 14, 62, 65, 67, 95, 108
Dolphin *Coryphaena equisetis*	19.0±0.4 18.5—19.8 3	1.6±0.8 0.7—3.2 3	75.4 2	1.5 2		94.3±6.6 85—107 3		147, 155

Table 1, continued

	Protein	Fat	Moisture	Ash	Carbohydrate	Energy	Cholesterol	References
			gm per 100 gm			*cal/100 gm*	*mg/100 gm*	
Dories *Zeidae spp*	18.4 18.3—18.4 2	1.05 0.9—1.2 2	78.1±0.7 77.0—79.3 3	1.3±0.03 1.2—1.3 3		80.0 1		11, 16, 144
Drum *Sciaenidae spp*	19.2±0.3 18.1—20.1 6	1.5±0.2 0.9—1.9 4	76.9±1.1 69.7—80.2 8	1.6±0.2 0.9—2.4 8		91.0 1		2, 11, 16, 72, 144
Drum, freshwater *Aplodinotus grunniens*	17.4±0.2 15.9—18.4 11	5.5±0.7 1.0—8.4 11	76.7±1.0 73.9—82.7 10	1.1±0.02 1.0—1.1 10				10, 23, 24, 28, 29, 45, 144
Eel, conger *Congridae spp*	16.4 2	4.5 2	77.6±1.0 76.3—79.5 3	1.2±0.2 1.0—1.5 3		110.5 99—122 2		16, 102
Eels, freshwater *Anguillidae spp*	18.0 2	17.3±2.6 12.7—21.5 3	65.0±1.8 62.2—70.1 4	1.3 2		246 237—255 2		11, 46, 63, 91,
Eels, snake *Ophichthidae spp*	17.7±0.4 15.3—20.2 18	0.9±0.2 0.1—3.1 18	78.8±0.5 74.0—81.1 17	1.3±0.1 0.2—2.6 18	0.6±0.2 0.3—2.4 10	81.4±3.3 73—104 11		5, 65, 71, 101, 104, 121, 143
Flatheads *Percophididae spp*	19.0±0.5 17.6—20.0 4	1.1±0.3 0.2—1.8 4	80.2±2.9 78.4—83.0 5	1.3±0.2 1.0—1.9 5		87±2.9 82—95 4		5, 16, 68, 121, 143
Flounder, winter *Pseudopleuronectes americanus*	17.4±2.3 16.0—19.9 6	0.8±0.5 0.2—3.0 6	79.5±0.9 75.4—81.0 6	1.3±0.0 1.2—1.3 5				6, 10, 14, 63, 95, 148
Flounders *Bothidae spp*	19.0±0.6 17.3—20.8 7	0.9±0.2 .1—2.5 11	78.1±0.7 76.0—80.1 7	1.7±0.2 1.3—2.3 4	0.6 0.4—0.8 2	84.3±5.4 78—95 3		5, 62, 65, 108, 115, 121, 148
Flounders *Pleuronectidae spp*	17.3±0.3 14.0—20.3 22	1.0±0.2 0.1—2.9 21	80.8±0.4 76.8—84.1 20	1.3±0.1 1.1—2.3 15	1.3 1	87.7±3.4 81—92 3		6, 10, 18, 59, 67, 84, 91, 98, 102, 135, 143, 151
Flyingfish and halfbeaks *Exocoetidae spp*	20.1±0.9 17.1—23.5 7	1.1±0.2 0.2—1.4 7	77.5±0.7 75.2—80.3 8	1.2±0.1 0.6—1.6 8	0.4 1	92.3±3.2 83—97 4		5, 11, 16, 65, 68, 108, 121
Goatfish, dwarf *Upeneus parvus*	19.8±0.2 18.7—21.5 14	4.0±0.5 1.6—7.0 14	75.2±0.6 71.7—78.4 15	1.8±0.1 1.6—2.5 15				60
Goatfishes *Mullidae spp*	20.1±0.7 16.9—22.9 9	2.0±0.5 0.4—4.7 9	76.3±0.6 74.5—78.1 6	1.7±0.5 0.6—4.0 6		106.3±5.0 99—120 4		11, 65, 147, 155
Gobies *Gobiidae spp*	17.4±0.6 15.4—20.5 11	1.1±0.3 0.1—2.7 11	79.3±0.5 76.5—81.8 11	1.8±0.2 1.0—2.9 11	0.3 1	75±0.6 74—76 3		5, 11, 65, 104, 108, 121, 143
Goosefishes *Lophiidae spp*	13.2±1.0 10.6—15.2 4	1.2±0.5 0.3—2.5 4	83.6±0.4 82.9—84.2 3	1.6±0.2 1.2—2.0 3		62.7±2.3 58—65 3		10, 11, 102
Groupers *Serranidae spp*	19.2±0.3 16.4—20.8 12	0.8±0.2 0.2—2.3 13	78.6±0.3 76.0—79.8 13	1.3±0.1 0.9—1.8 13	1.0 1	87.4±2.3 83.0—94.0 5		9, 11, 16, 54, 62, 65, 67, 121, 143
Grunts *Pomadasyidae*	19.2±0.4 17.7—21.1 9	0.9±0.3 0.2—2.7 9	77.9±0.5 75.6—79.8 9	1.8±0.3 1.1—3.5 9	2.2 1	87.3±2.3 80—92 6		54, 67, 108, 121, 155
Haddock *Melanogrammus aeglefinus*	18.3±0.3 15.4—19.6 13	0.5±0.2 0.1—1.2 5	80.3±0.3 79.1—81.7 11	1.1±0.1 1.0—1.2 3		79 1	66.3±13.0 45.0—90.0 3	8, 10, 14, 35, 59, 118, 125
Hakes *Merluccius spp*	16.3±0.3 15.4—16.9 4	1.2±0.5 0.6—2.7 4	81.1±1.0 78.5—83.1 4	1.2±0.1 1.0—1.5 4		86 1		6, 11, 35, 144
Halibut, Atlantic *Hippoglossus hippoglossus*	17.7±1.3 12.6—20.1 5	2.4±0.9 0.7—5.2 5	78.1±0.7 76.5—82.9 9	1.1 1		126 1	60 1	13, 63, 88, 119

Table 1, continued.

	Protein	Fat	Moisture	Ash	Carbohydrate	Energy	Cholesterol	References
			gm per 100 gm			*cal/100 gm*	*mg/100 gm*	
Halibut, Pacific	21.1±0.1	1.1±0.2	77.9±0.1	1.4±0.0				10, 119, 141
Hippoglossus stenolepis	20.3—22.0	0.6—3.6	77.3—78.7	1.2—1.4				
	12	13	16	12				
Herring, Atlantic	18.2±0.8	15.7±1.9	60.1±2.5	1.7				14, 87
Clupea harengus	15.2—21.9	2.4—29.1	52.6—78.0					
	7	17	11	1				
Herring, fimbriated	20.0±0.4	2.0±0.5	76.1±0.8	2.0±0.2	1.7	102.3±8.9		9, 121
Sardinella fimbriata	18.3—21.8	0.4—3.6	71.3—78.1	1.3—3.4	0.6—2.7	88—128		
	7	6	8	8	2	4		
Herring, lake, trout	18.8±0.9	3.3±1.04	77.6±1.1	1.4±0.2				45, 73
Coregonus artedii	15.6—20.8	1.5—7.2	62.6—81.3	1.0—2.8				
	6	6	18	8				
Herring, Pacific	14.6±1.7	11.1±1.6	71.5	3.8±0.9				10, 31, 38, 41
Clupea harengus pallasi	9.4—16.5	8.0—12.8	69.0—73.9	2.5—3.3				
	4	3	2	7				
Jack mackerel	19.7	6.8±4.3	76.7	1.2				62, 144
Trachurus trachurus		1.5—15.3						
	1	3	1	1				
Jacks	19.9±0.4	1.2±0.5	76.5±0.5	1.5±0.1	0.6±0.4	96.6±45		9, 16, 26, 65,
Caranx spp	16.6—22.0	0.1—6.1	71.5—79.8	1.0—2.7	0.2—1.4	84—135		73, 112, 121,
	14	12	16	15	3	10		155
Kingfishes	17.2±0.3	3.1±1.1	78.4±1.2	1.1±0.1				14, 95
Menticirrhus spp	16.5—17.9	0.7—6.1	75.3—81.7	1.1—1.3				
	5	5	5	5				
Leatherjacket	19.9±0.3	1.3±0.4	77.1±0.4	1.6±0.1	0.3	109		5, 121, 143
Scomeroides lysan	19.3—20.7	0.1—1.8	76.4—77.7	1.3—1.8		88—130		
	4	4	4	4	1	2		
Lingcod	17.5±0.4	0.7±0.2	80.2	1.2±0.0		99		10, 133, 137,
Ophiodon elongatus	16.7—18.1	0.5—1.0	79.2—81.1	1.2—1.2		81—117		153
	3	3	2	3		2		
Lizardfish	19.3±0.3	1.13±0.1	78.2±0.3	1.7±0.1				60, 65, 121
Saurida tumbil	17.4—23.5	0.1—1.8	76.3—80.2	1.4—2.2				
	17	18	17	17				
Lizardfish	19.4±0.2	2.3±0.2	77.0±0.3	1.8±0.1	0.9	88		60, 143
Saurida undosquamis	18.4—20.9	0.5—3.4	75.6—79.2	1.5—2.2				
	13	13	13	12	1			
Lobster	19.6±0.8	1.3±0.2	76.0±1.1	2.4±0.6	0.8	95	260	10, 16, 35, 42, 56,
Panulirus spp	16.2—21.6	0.6—1.9	71.5—81.2	1.2—3.4		92—98	170—350	59, 63, 84, 90,
	7	6	10	4	1	2	2	143
Mackerel	22.0±0.3	5.3±0.7	71.7±0.6	1.5±0.04	0.3	114±3.6		5, 43, 60, 67, 107,
Scomber spp	13.5—25.3	0.3—18.1	61.4—77.7	1.1—2.4		108—124		108, 109, 112,
	44	42	45	43	1	4		143, 144, 155
Mackerel	18.9±0.5	3.7±1.4	74.9±1.4	1.3±0.1	2.8±0.1	103.4±17.3		2, 10, 14, 54, 65,
Scombermorus spp	15.9—22.4	0.2—14.4	63.0—82.1	0.9—1.6	2.6—3.0	80—172		67, 72, 95, 109,
	16	13	15	15	3	5		112, 121, 133, 155
Mackerel	24.8	3.2±1.2	71.2	1.4				62, 65, 121
Auxis spp	23.7—25.8	0.7—7.2	70.2—72.2	1.3—1.5				
	2	5	2	2				
Mackerel, Atlantic	19.1±0.6	16.3±2.1	64.0±1.9	1.5±0.1		169±30.7	80	10, 59, 89, 93,
Scomber scomberus	15.1—23.1	0.7—24.0	49.3—78.6	1.0—3.0		84—230		102, 118
	17	17	15	15		4	1	
Mackerel, Indian	19.1±0.7	2.0±0.4	76.4±0.8	1.5±0.1	2.1±0.2	97.7—3.8		12, 65, 70, 121,
Rastrelliger spp	16.6—21.4	0.5—4.1	73.3—79.3	1.1—2.2	1.8—2.5	92—105		145
	9	14	9	9	3	3		
Mackerel, Pacific	21.2	4.6±2.5	72.3	2.4				62, 93
Pneumatophorus japonicus		1.6—9.5						
	1	3	1	1				
Mojarras	18.6±0.6	1.3	78.5±0.2	1.6±0.3		84		65, 67, 121
Gerreidae spp	17.7—19.6	1.2—1.3						
	3	2	3	3		1		

Table 1, continued.

	Protein	Fat	Moisture	Ash	Carbohydrate	Energy	Cholesterol	References
			gm per 100 gm			*cal/100 gm*	*mg/100 gm*	
Mullet *Mugil* spp	19.2 ± 0.7 12.3—22.6 14	3.3 ± 0.5 0.4—5.9 11	75.3 ± 1.1 69.3—86.0 15	1.4 ± 0.1 0.9—2.1 13	2.2 1.9—2.4 2	128.4 ± 13.4 103—124 5		34, 65, 72, 90, 101, 104, 105, 112, 121, 143, 144
Mullet, striped *Mugil cephalus*	19.4 ± 0.4 17.9—21.8 11	5.5 ± 1.3 0.2—14.8 12	73.7 ± 1.4 64.5—80.2 11	1.3 ± 0.1 1.0—1.8 10		143 ± 13.7 102—219 8		5, 11, 54, 68, 95, 102, 108, 147
Mullet, red *Mullus barbatus*	19.0 ± 0.4 16.8—23.0 19	5.0 ± 0.7 0.8—10.8 19	75.3 ± 0.8 68.4—79.9 19	1.7 ± 0.1 1.3—2.1 18				11, 111
Needlefishes *Belonidae* spp	23.2 ± 1.8 20.6—26.6 3	1.1 ± 0.5 0.3—2.1 3	74.9 ± 2.3 70.4—78.0 3	1.6 ± 0.1 1.4—1.8 3		84.5 78—91 2		11, 65, 143
Ocean perch, Pacific *Sebastes alutus*	18.1 ± 0.6 17.2—19.2 3	1.4 ± 0.1 1.2—1.5 3	79.1 ± 0.4 78.4—79.8 3	1.2 ± 0.03 1.1—1.2 3				66, 137
Oysters *Ostreidae* spp	7.8 ± 0.5 5.0—14.3 22	1.5 ± 0.1 0.7—2.6 21	84.8 ± 0.9 76.0—93.0 26	1.8 ± 0.1 1.1—2.7 19	4.2 ± 0.3 2.3—6.5 20	78.5 ± 5.7 54—92 6	262 ± 52.9 112—470 6	10, 16, 33, 42, 57, 59, 65, 81, 94, 98, 103, 123, 125, 143
Oyster, blue point *Crassostrea virginica*	6.9 ± 0.3 5.6—10.0 24	1.5 ± 0.1 0.7—2.4 24	85.7 ± 0.5 77.4—90.2 40	1.5 ± 0.1 0.7—2.9 23	3.3 ± 0.2 1.9—4.7 18		47.5 37—58 2	10, 53, 82, 126, 131, 146, 154
Parrotfishes *Scaridae* spp	19.7 ± 0.7 18.9—21.0 3	0.9 ± 0.5 0.4—2.0 3	78.7 ± 1.4 75.8—80.2 3	1.3 ± 0.1 1.1—1.5 3		105 1		65, 67, 143
Perch, yellow *Perca flavescens*	19.0 ± 0.3 17.3—19.9 9	0.9 ± 0.1 0.5—1.2 8	79.1 ± 0.3 78.3—80.2 6	1.4 ± 0.3 0.6—3.3 8				10, 19, 20, 45, 140
Perches *Serranidae* spp	18.0 1	1.0 ± 0.4 0.3—1.5 3	81.1 ± 0.5 80.4—82.0 3	1.2 1.1—1.2 2		83 1		11, 16, 62, 67, 115
Pikes *Esocidae* spp	19.0 18.2—19.7 2	1.2 1.2—1.2 2	77.9 ± 1.8 72.5—80.2 4	1.2 1.1—1.3 2				31, 84, 140
Pilchards *Sardinops* spp	16.7 ± 0.6 14.7—19.4 7	2.0 ± 0.7 0.3—5.2 7	76.7 ± 0.6 74.5—78.9 7	3.7 ± 0.6 1.1—4.9 7		87.3 ± 10.3 70—117 4		11, 68
Pilchard *Sardina caerulea*	19.2 ± 0.2 16.9—21.4 30	8.0 ± 1.1 0.3—21.4 32	71.4 ± 1.1 59.7—79.7 30	1.8 ± 0.3 1.3—2.7 4				44, 93, 152
Pollack, coalfish *Pollachius virens*	18.6 ± 0.3 17.4—19.3 7	0.5 ± 0.1 0.2—1.0 7	79.2 ± 0.7 77.4—81.6 6	1.6 ± 0.1 1.3—2.0 6				6, 10, 18, 102
Pollack, walleye *Theragra chalcogramma*	17.4 16.8—18.0 2	0.9 0.7—1.0 2	82.5 1	1.1 1				6, 35
Pomfrets *Bramidae* spp	18.9 ± 0.6 16.2—21.6 10	1.1 ± 0.3 0.6—1.4 3	76.5 ± 1.1 70.6—80.3 10	1.3 ± 0.2 0.4—2.2 7	2.8 1.3—2.3 2	93.3 ± 4.1 84—101 4		72, 90, 102, 109, 112, 121, 155
Pompano *Trachinotus* spp	19.3 ± 0.4 17.6—21.0 8	1.4 ± 0.4 0.2—4.0 8	77.3 ± 0.6 75.3—80.4 8	1.2 ± 0.1 0.4—1.5 8	2.8 1	86.2 ± 3.4 83—99 5		54, 65, 121, 155
Porgies *Dentex* spp	19.9 ± 0.5 18.7—21.4 5	1.8 ± 0.5 1.0—3.5 5	77.4 ± 0.7 76.4—80.0 5	1.6 ± 0.2 1.3—2.1 5		94.7 ± 5.2 86—104 3		9, 11, 144
Porgies *Sparus* spp	20.8 ± 0.4 19.0—22.8 8	1.8 ± 0.5 0.2—4.9 10	75.3 ± 0.5 73.6—77.4 8	1.5 ± 0.2 1.3—2.5 8	1.1 0.7—1.5 2	100.7 ± 3.5 90—115 6		5, 86, 108, 121, 143, 144, 155
Porgies *Pagrus* spp	20.3 ± 0.2 19.9—20.5 3	1.2 ± 0.5 0.6—2.2 3	77.1 ± 0.2 76.9—77.5 3	1.5 ± 0.2 3		102 1		9, 144

Table 1, continued.

	Protein	Fat	Moisture	Ash	Carbohydrate	Energy	Cholesterol	References
	gm per 100 gm					cal/100 gm	mg/100 gm	
Porgy	19.0±0.8	6.3±1.3	73.5±1.5	1.9±0.2		128.8±13.8		11, 102
Box boops	17.3—20.9	4.5—10.1	69.3—76.5	1.4—2.4		113—170		
	4	4	4	4		4		
Prawns	16.8±1.1	1.2±0.2	75.3±1.0	2.7±0.3				2, 16, 35, 77, 90, 112, 113, 114
Miscellaneous spp	8.9—23.2	0.3—3.1	67.5—80.6	1.6—5.2				
	19	17	20	14				
Puffer	23.2	0.7	74.2	1.1				39, 65
Sphoeroides spp				1.0—1.2				
	1	1	1	2				
Redfish	18.0±0.1	1.3±0.2	79.4±0.2	1.1±0.0				10, 32, 118, 133
Sebastes marinus	17.9—18.1	0.6—2.2	78.8—79.6	1.1—1.1				
	7	7	6	6				
Rockfishes	18.8±0.3	1.2±0.2	78.3±0.5	1.2±0.02				10, 106, 107, 117, 133, 136
Sebastes spp	17.2—20.8	0.2—2.4	75.1—80.0	1.1—1.3				
	13	14	12	11				
Sablefish	13.3	14.0	71.5	1.0				10, 137
Anoplopoma fimbria	12.9—13.6	12.8—15.2						
	2	2	1	1				
Salmon, chinook	16.2±0.4	11.5±2.4	67.6±2.2	0.9±0.02				10, 55
Oncorhynchus tshawytscha	13.4—17.6	2.2—19.0	61.3—79.9	0.9—1.0				
	10	8	10	10				
Salmon, chum	20.7±0.7	4.3±0.6	73.8±1.4	1.5±0.1				10, 61, 64
Oncorhynchus keta	18.4—24.5	1.3—4.8	68.9—78.3	1.2—1.7				
	9	11	8	8				
Salmon, coho	21.5±0.1	5.7±0.5	72.7±0.5	1.2±0.01				10, 69, 116
Oncorhynchus kisutch	20.5—22.0	3.1—9.0	70.3—75.3	1.1—1.3				
	14	14	13	13				
Salmon, pink	19.4±0.2	5.3±0.4	74.0±0.5	1.2±0.02			65	10, 40, 61, 120, 134, 139
Oncorhynchus gorbuscha	17.2—20.6	2.0—9.4	69.0—78.3	1.1—1.4				
	22	36	33	21			1	
Salmon, sockeye	20.9±0.5	7.5±1.2	72.8±1.4	1.2±0.02				10, 61, 84, 115, 142
Oncorhynchus nerka	17.9—22.7	1.6—19.2	65.6—80.3	1.1—1.3				
	13	16	14	12				
Sandlanches	17.9	1.5	78.0	2.8		87.0		102
Ammodytes lancedatus								
	1	1	1	1		1		
Sardine	19.0	3.7	77.1	2.6				9
Sardinella eba								
	1	1	1	1				
Sardine, gilt	20.5±0.2	3.8±0.3	74.8±0.3	2.1±0.1				9, 60
Sardinella aurita	17.3—22.3	0.4—20.0	65.9—79.9	1.4—2.9				
	49	125	50	49				
Sardine, Indian	19.3±0.7	2.9±0.6	75.7±0.1	1.5±0.1	0.7	103±6.0		5, 65, 108, 121
Sardinella longiceps	17.7—21.0	1.9—4.6	75.3—76.0	1.3—1.6	0.1—1.3	91—110		
	4	4	4	4	2	3		
Scad	21.8±1.5	2.4±0.7	75.4	1.5	1.2	109		65, 121, 147
Decapterus spp	19.2—24.4	1.0—4.9	74.2—76.6	1.1—1.8		101—117		
	3	5	2	2	1	2		
Scallop	17.2±0.7	0.7±0.2	79.2±0.8	1.7±0.1				10, 16, 63, 84, 91, 125, 131, 150
Pectinidae spp	15.2—20.1	0.3—1.6	74.6—85.6	1.3—1.8				
	7	7	11	6				
Scallop, Atlantic Bay	15.4±0.2	0.5±0.03	80.7±0.4	1.4±0.04	1.7±0.2		105.7±35.2	150
Pecten irradians	13.4—17.0	0.3—0.9	74.6—83.7	1.1—1.7	1.4—1.9		60—175	
	24	24	24	24	3		3	
Scallop, calico	15.9±0.2	0.6±0.06	79.8±0.4	1.5±0.03				150
Aequipecten gibbus	15.6—16.4	0.5—0.7	78.8—80.4	1.4—1.5				
	4	4	4	4				
Scup	18.8±0.1	3.7±0.8	75.5±0.6	1.2±0.1				14, 95, 148
Stenotomus chrysops	18.4—19.1	1.2—5.9	73.6—77.0	1.1—1.4				
	5	5	5	5				

Table 1, continued.

	Protein	Fat	Moisture	Ash	Carbohydrate	Energy	Cholesterol	References
	gm per 100 gm					*cal/100 gm*	*mg/100 gm*	
Shad *Alosa sapidissima*	18.5±0.5 15.7—20.0 9	8.3±1.7 1.7—15.2 9	71.4±1.4 64.6—77.0 9	1.5±0.1 1.2—1.9 9				5, 14, 95, 108, 143
Shad *Clupeidae* spp	17.4±0.7 15.1—21.5 8	12.0±3.6 1.2—23.1 6	70.2±2.6 58.0—78.3 8	2.1±0.4 1.2—4.2 8		87 1		45, 65, 112, 121, 140
Sharks Mixed spp	22.7±0.8 14.9—27.1 18	0.5±0.2 0.1—2.9 14	76.3±0.5 72.0—76.9 17	1.3±0.1 1.0—2.0 17		101±4.3 4		54, 65, 67, 68, 72, 90, 102, 112
Shrimp Miscellaneous spp	20.5±0.71 16.2—22.7 16	1.1±0.2 0.1—3.2 19	76.2±0.7 69.6—84.8 26	2.6±0.5 1.3—6.8 14	2.2 2	88.3±9.7 69—99 3	159.5±13.8 138—200 4	10, 16, 35, 37, 42, 56, 59, 94, 98, 108, 125, 127, 131, 143
Skates *Rajidae* spp	20.3 19.0—21.5 2	0.2 1	78.0±0.9 76.4—79.6 3	1.3 1.1—1.4 2		80 1		16, 90, 102
Skipjack *Euthynnus pelamis*	25.5±0.4 23.8—26.6 8	3.4±0.6 0.3—7.4 14	70.0±0.4 68.6—71.1 6	1.5±0.1 1.3—1.7 7				43, 50, 61, 62, 70, 147
Smelts *Osmeridae* spp	16.6±0.6 14.3—18.8 9	3.9±0.7 2.3—6.7 9	79.0±0.4 76.8—80.2 8	1.5±0.2 1.1—2.3 6				10, 21, 45, 91, 125, 140
Snappers *Lutjanidae* spp	19.2±0.4 16.7—21.9 16	2.0±0.5 0.4—7.4 16	77.9±0.5 72.7—81.9 19	1.3±0.1 1.0—1.7 15	0.7±0.2 .2—1.3 4	99.5±5.2 82—146 12		5, 9, 16, 34, 54, 65, 67, 68, 84, 96, 121, 143, 147, 155
Snooks *Centropomidae* spp	18.5±1.1 13.7—20.6 6	0.9±0.2 0.3—1.9 6	78.3±0.7 77.0—82.0 8	1.2±0.1 1.0—1.5 8	0.6 0.2—0.6 2	82.5 79—86 2		16, 54, 65, 104, 121
Soles *Limanda* spp	18.0±0.4 17.0—19.2 6	1.0±0.2 0.1—1.3 6	81.1±0.3 80.0—82.7 6	1.3±0.1 1.1—1.5 4				6, 10, 18, 135
Sole *Soleidae*	18.7±1.3 16.6—21.2 3	1.07±0.5 0.2—1.7 3	78.4±1.2 75.0—80.1 4	1.7±0.2 1.3—2.1 4		82.5 80—85 2		11, 16, 102, 144
Sole, Dover *Microstomus pacificus*	15.0±0.3 13.9—16.6 7	0.8±0.1 0.6—1.2 6	83.7±0.3 82.6—84.4 6	1.1±0.0 1.1—1.1 4				10, 117, 120, 135
Sole, English *Parophys ventulus*	17.1±0.4 16.4—18.5 5	1.4±0.1 1.2—1.8 5	81.2±0.2 80.7—81.8 4	1.2±0.0 1.2—1.3 5				10, 18, 133, 135
Sole, Petrole *Eopsetta jordani*	17.4±0.8 14.8—19.4 6	2.4±0.9 0.9—6.7 6	78.5±1.0 74.8—81.0 5	1.8±0.5 1.2—3.8 5		85.0 1		10, 11, 135
Spot *Leiostomus xanthurus*	17.9 1	3.1 1	77.5 1	1.1 1				95
Sprat *Clupea sprattus*	16.9 16.7—17.1 2	6.7 1.8—11.6 2	69.2±1.2 66.8—71.0 3	1.9±0.1 1.8—2.0 3		176 1		16, 35, 102
Squawfish, northern *Ptychocheilus oregonensis*	17.0±0.4 15.6—18.0 7	2.5±0.2 1.8—3.1 7	79.3±0.2 78.8—80.1 7	1.1±0.02 1.0—1.1 7				28, 140
Squid *Loliginidae* spp	15.3±1.1 11.9—18.4 6	1.0±0.2 0.5—1.4 6	79.3±1.6 74.2—84.0 6	1.8±0.3 1.0—3.1 7	3.0 1	89 80—98 2		38, 65, 67, 80, 108, 143
Surgeonfish *Acipenseridae* spp	18.7±0.5 17.4—20.9 6	1.3±0.5 0.4—3.8 6	80.3±1.9 74.4—89.0 6	1.0±0.2 0.3—1.4 5	1.3 1.3—1.3 2	92.2±6.9 81—119 5		65, 121, 143, 147
Swordfish *Xiphias gladius*	19.5±0.4 18.6—20.8 6	4.1±0.7 2.0—6.4 6	76.2±0.4 74.7—77.5 6	1.3±0.1 1.0—1.9 6	0.7 1	100 87—113 2		11, 85, 89, 143

Table 1, continued.

	Protein	Fat	Moisture	Ash	Carbohydrate	Energy	Cholesterol	References
	gm per 100 gm					*cal/100 gm*	*mg/100 gm*	
Trouts *Salmonidae* spp	16.1±1.1 12.4—19.0 5	11.0±1.1 8.7—14.0 5	71.3±1.8 64.0—76.3 6	1.3±0.2 1.0—2.0 5				35, 91
Trout, brook *Salvelinus fontinalis*	17.5 13.7—21.2 2	4.5 3.4—5.5 2	74.5±1.2 71.5—77.2 4	2.7 2.0—3.3 2				63, 97
Trout, Dolly Varden *Salvelinus malma*	19.9 1	6.5 1	73.1 1	1.2 1				31
Trout, lake *Salvelinus namaycush*	16.4±0.9 11.3—20.0 9	14.9±2.7 9.1—36.0 10	69.3±2.1 52.5—79.0 11	1.2±0.3 0.5—3.3 8				26, 45, 83, 84, 138, 140
Trout, rainbow *Salmo gairdneri*	22.0 1	11.7 1	72.0 66.3—77.7 2	1.3 1				31, 91
Tuna, big eye *Thunnus obesus*	22.5 1	1.3±0.3 0.6—2.0 4	73.1 1	1.3 1		98 1		61, 155
Tuna, bluefin *Thunnus thynnus*	24.7±0.3 23.3—27.5 13	3.9±0.6 1.2—8.0 13	70.4±0.4 67.7—72.6 13	1.3±0.02 1.2—1.4 12		122±3.2 114—129 5		11, 43, 68, 70, 89, 147, 155
Tuna, yellowfin *Thunnus albacares*	24.3±0.2 22.9—25.8 26	2.2±0.5 0.1—9.5 25	73.2±0.5 67.3—77.1 27	1.5±0.03 1.3—1.9 25				10, 16, 43, 65, 70, 78, 93, 107, 147
Tunny, little *Euthynnus alletteratus*	22.8±0.1 22.0—25.4 48	5.7±0.8 0.7—20.2 48	69.8±0.7 59.0—74.4 47	1.6±0.02 1.2—2.1 48				9, 60, 96
Turbot *Rhombus maximus*	16.4 2	2.9 2	78.3 2	1.0 2		94 74—114 2		102
Walleye *Stizostedion vitreum*	19.3±0.2 18.8—19.8 4	1.5±0.3 0.8—1.9 4	79.3±0.6 78.2—80.0 3	1.2±0.03 1.1—1.2 3				133, 140
Weakfish *Cynoscion regalis*	18.7±0.6 15.7—20.0 7	3.2±0.4 1.4—4.3 7	76.6±0.7 74.6—79.6 7	1.19±0.03 1.1—1.3 7				14, 15, 95
Whitefish, lake, trout *Coregonus clupeaformus*	18.0±0.3 15.1—19.8 16	7.6±1.2 1.7—18.5 17	73.4±1.3 62.6—79.0 14	1.3±0.1 1.0—3.1 15				10, 110, 133
Whiting *Merluccius bilinearis*	16.1±0.3 15.2—16.7 6	1.2±0.3 0.2—2.0 6	80.7±0.5 79.3—82.4 5	1.2±0.02 1.1—1.2 5		87.7±11.8 73—111 3	75 1	6, 10, 14, 17

[1] Standard error of the mean.
[2] Range.
[3] This number of averages used to compute the overall average.

factors that influence the fat and moisture content do not cause much variation in the protein and ash content of the edible portion of the fish.

The variability of the fat content of fish flesh is reflected in the energy values. The energy values listed in Table 1 were, in all cases, calculated values, that is:

$$\text{Estimated energy value} = (\text{protein} \times 4) + (\text{fat} \times 9) + \text{carbohydrate} \times 4)$$

Values for the cholesterol content of raw edible fish are very limited. More work needs to be done in this area because the medical services can use this data in the dietary treatment of certain vascular diseases. Indications are that fish can play a significant role in the dietary regime for certain diseases.

Table 1 does not represent all of the available data on the proximate and energy values of raw edible portions of crustaceans, finfish, and mollusks. This interim report, however, will give a useful résumé until more data becomes available.

SUMMARY

Table 1 lists the values for the overall average for protein, fat, moisture, ash, carbohydrate, energy, and cholesterol; the range of the averages used to compute the mean and standard

error of the mean; and also the number of averages used in the computation for 154 different fish. This review contains data from 155 references.

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LITERATURE CITATIONS

1. Alexander, K. M. 1955. A comparison of the gross chemical composition of the red and white muscles in the two fishes, *Scatophagus argus* and *Labeo rohita*. J. Anim. Morphol. Physiol. 1 (2):58-61.
2. Appanna, T. C. 1942. Comparative studies on the nutritive value of fish and prawns muscle. Curr. Sci. (India). 11:333-335.
•3. Arakaki, J., and M. Suyama. 1966. Amino acid composition of the protein of anchovy. Bull. Jap. Soc. Sci. Fish. 32:70-73.
4. Baba, H. 1954. The components of short necked clams. Annu. Rep. Nat. Inst. Nutr. (Japan). 45:46.
5. Balagtas, A. N. 1928. Chemical composition of Philippine fish. Philipp. Agric. Rev. 17:253-261.
6. Brooke, R. O., E. M. Ravesi, and M. A. Steinberg. 1962. The composition of commercially important fish taken from New England waters. II. Proximate analyses of butterfish, flounder, pollock, and hake, and their seasonal variation. Food. Res. 27:73-76.
7. Brooke, R. O., E. M. Ravesi, D. F. Gadbois, and M. A. Steinberg. 1964. Preservation of fresh unfrozen fishery products by low-level radiation. Food Technol. 18(7): 116-120.
8. 1966. Preservation of fresh unfrozen fishery products by low-level radiation. Food Technol. 20:1479-1482.
9. Busson, F. 1953. Nutritional value of the fish caught off the coasts of the Cape Verde Peninsula. Méd. Trop. 13:534-537.
10. Butler, C. 1958. Nutritional value of fish in reference to atherosclerosis and current dietary research. Commer. Fish. Rev. 20(7):7-16.
11. Carteni, A. 1934-1935. Zime chimica di animali marini del goefo di Napoli. Quaderai della Nutriz. 1:49-63.
12. Chidambaram, K., C. G. Krishnamurthy, R. Venkataraman, and S. I. Chari. 1952. Studies on mackerel: Fat variations—and certain biological aspects. Proc. Indian Acad. Sci. Sect B. 35:43-68.
13. Chittenden, R. H. 1877. On the chemical composition of the flesh of *Hippoglossus americanus*. Am. J. Sci. 113:123-124.
14. Clark, E. D., and L. H. Almy. 1918. A chemical study of food fishes. The analysis of twenty common food fishes with especial reference to a seasonal variation in composition. J. Biol. Chem. 33:483-498.
15. 1920. A chemical study of frozen fish in storage for short and long period. J. Ind. Eng. Chem. 12(7):656-663.
16. Clements, F. W., and R. C. Hutchinson. 1939. The ash constituents of Australian fish. Aust. J. Exp. Biol. Med. Sci. 17:89-92.
17. Cohen, E. H., and J. A. Peters. 1963. Effect of storage in refrigerated sea water on amino acids and other components of whiting *(Merluccius bilinearis)*. U.S. Fish Wildl. Serv., Fish. Ind. Res. 2(2):5-11.
18. Commercial Fisheries Review. 1950. Nutrition and composition. Commer. Fish Rev. 12(6):10.
19. 1952a. Composition and cold-storage life of fresh-water fish. Commer. Fish. Rev. 14(1):17.
20.11952b. Composition and cold-storage life of fresh water fish. Commer. Fish Rev. 14(2):30.
21. 1952c. Cold-storage life and composition of fresh-water fish. Commer. Fish. Rev. 14(5):13.
22. 1952d. Composition and cold-storage life of fresh-water fish. Commer. Fish Rev. 14(8):13.
23. 1952e. Composition and cold-storage life of fresh-water fish. Commer. Fish. Rev. 14(1):17.
24. 1952f. Analysis and composition: Composition and cold-storage life of fresh-water fish. Commer. Fish. Rev. 14(11):10.
25. 1952g. Composition and cold-storage life of fresh-water fish. Commer. Fish. Rev. 14(12):15.
26. 1953a. Composition and cold-storage life of fresh-water fish. Commer. Fish. Rev. 15(3):30.
27. 1953b. Vitamin content and nutritive value of fishery byproducts. Commer. Fish. Rev. 15(3):29-30.
28. 1953c. Composition of fish. Commer. Fish. Rev. 15(10):17-18.
29. 1953d. Composition of fish. Commer. Fish. Rev. 15(12):14-15.
30. 1954a. Composition of fish. Commer. Fish. Rev. 16(4):12.
31. 1954b. Composition of fish. Commer. Fish. Rev. 16(7):20.
32. 1956. Fish composition studies. Commer. Fish. Rev. 18(12):26-27.
33. Coulson, E. J. 1934. The iodine content of oysters. [U.S.] Bur. Fish., Invest. Rep. 18, 10 p.
34. 1935. The iodine content of some American fishery products. [U.S.] Bur. Fish., Invest. Rep. 25, 7 p.
35. Cox, H. E. 1935. The composition of fish pastes. Analyst 60:71-77.
36. Dabrowski, T., E. Kolakowski, H. Wawreszuk, and C. Choroszucha. 1966. Studies on chemical composition of American crayfish (*Orconectes limosus*) meat as related to its nutritive value. J. Fish. Res. Board Can. 23:1653-1662.
37. Dabrowski, T., E. Kolakowski, and B. Karnicka. 1969. Chemical composition of shrimp flesh *(Parapenaeus* spp.) and its nutritive value. J. Fish Res. Board Can. 26:2969-2974.
38. Da Coasta, A., and J. A. Stern. 1956. The calcium and phosphorus contents of some foreign and domestic canned sardines. Food Res. 21:242-249.
39. Darling, D. B., and H. W. Nilson. 1946. Nutritive value of the protein of swellfish. Commer. Fish. Rev. 8(8):10-11.
40. Davidson, F. A., and O. E. Shostrom. 1936. Physical and chemical changes in the pink salmon during the spawning migration. [U.S.] Bur. Fish., Invest. Rep. 33, 37 p.
41. Deas, C. P., and H. L. A. Tarr. 1949. Amino acid composition of fishery products. J. Fish. Res. Board Can. 7:513-521.
42. Dick, J., and L. I. Pugsley. 1950. The arsenic, lead, tin, copper, and iron content of canned clams, oysters, crabs, lobsters, and shrimp. Can. J. Res. Sect. F. 28:199-201.
43. Dill, D. B. 1921a. A chemical study of certain Pacific Coast fishes. J. Biol. Chem. 48:73-82.
44. 1921b. A chemical study of the California sardine *(Sardinia caerulea)*. J. Biol. Chem. 48:93-103.
45. Dugal, L. C. 1962. Proximate composition of some freshwater fish. Fish. Res. Board Can., Biol. Stn. Lond., Ont. Circ. 5, p. 1-6.
46. Edisbury, J. R., J. A. Lovern, and R. A. Morton. 1937. LVIII. Distribution of vitamin A in the tissues of the eels *Anguilla vulgaris* and *A. aucklandi* Rich. Biochem. J. 31:416-423.
47. Farragut, R. N. 1965. Proximate composition of Chesapeake Bay blue crab *(Callinectes sapidus)*. J. Food Sci. 30:538-544.
48. Farragut, R. N., and M. H. Thompson. 1965. Proximate composition of the Pacific Coast dungeness crab *(Cancer magister)*. U.S. Fish Wildl. Serv., Fish. Ind. Res. 3(3):1-4.
49. Fellers, C. R., and C. T. Parks. 1926. Biochemical study and proximate composition of Pacific Coast crabs. Univ. Wash. Publ. Fish. Vol. 1, No. 7, 18 p.
50. Fujimaki, M., S. Odagiri, and C. Inagaki. 1953. On the so-called vitamin C of canned bonito in brine. [*In* Jap., Engl. summ.] Bull. Jap. Soc. Sci. Fish. 18:703-708.
51. Gangal, S. V., and N. G. Magar. 1962. Chemical composition of crabmeat. Indian J. Appl. Chem. 25:133-136.
52. 1963. Freezing of crabmeat. Food Technol. 17:101-106.
53. Goldbeck, C. G. 1947. Some studies on the content of thiamine and antithiamine factor in fishery products. Commer. Fish. Rev. 9(8):13-21.
54. Gonzalez-Diaz, C., and O. Fernandez V. 1948. Valor nutritive del pescado fresco que se consume en la Ciudad de Mexico. An. Esc. Nag. Ciencias. 5:283-290.
55. Greene, C. W. 1919. Biochemical changes in the muscle tissue of king salmon during the fast of spawning migration. J. Biol. Chem. 39:435-456.
56. Harry, R. G. 1936. The composition of certain cooked fish. J. Soc. Chem. Ind. 55:150-151.
57. Hastings, W. H., and F. Spencer. 1952. Determinations of free and bound ascorbic acid in fishery products. J. Mar. Res. 11:241-244.
58. Hatakoshi, Y. 1932. Composition of canned meat of the crab. J. Chem. Soc. Jap. 53:1026-1027.
59. Hayes, O. B., and G. Rose. 1957. Supplementary food composition table. J. Am. Diet. Assoc. 33:26-29.
60. Herzberg, A., and R. Pasteur. 1969. Proximate composition of commercial fishes from the Mediterranean Sea and the Red Sea. U.S. Fish Wildl. Serv., Fish. Ind. Res. 5:39-65.
61. Hirao, S., J. Yamada, and R. Kikuchi. 1954. Vitamin A in fish meat.—I. Variation in the vitamin A content in fish meat by the anatomical locality. [*In* Jap., Engl. summ.] Bull. Jap. Soc. Sci. Fish. 19:1047-1060.
62. 1955. Vitamin A in fish meat.—III. Individual fluctuation in the vitamin A content in fish meat. [*In* Jap., Engl. summ.] Bull. Jap. Soc. Sci. Fish. 20:853-861.
63. Hoar, W. S., and M. Barberi. 1945. Distribution of riboflavin in fresh and processed fish. Can. J. Res. Sect. E. 23:8-18.
64. Igarashi, H., and K. Zama. 1953. Biochemical studies of the salmon, *Oncorhynchus keta*.—I. The changes in the chemical components of the body tissues

during the spawning migration. [*In* Jap., Engl. summ.] Bull. Jap. Soc. Sci. Fish. 18: 618-622.
65. Intengan, C. L., L. G. Alejo, I. Concepcion, V. A. Corpus, R. D. Salud, I. Del Rosario, R. Gomez, and J. Henson. 1956. Composition of Philippine Foods, V. Philipp. J. Sci. 85:203-213.
66. Iverson, J. L. 1958. Pacific Ocean perch-proximate composition. Tech. Note No. 48 Commer. Fish. Rev. 20(12): 22-24.
67. Jaffe, W. G. 1956. Composition of Venezuelan fishes. Archos, Venez. Nutr. 7:163-166.
68. Jowett, W. G., and W. Davies. 1938. A chemical study of some Australian fish. Aust. Counc. Sci. Ind. Res., Pam. No. 85, 40 p.
69. Karrick, N. L., and C. E. Thurston. 1964. Proximate composition of silver salmon. J. Agric. Food. Chem. 12:282-284.
70. 1968. Proximate composition and sodium and potassium contents of four species of tuna. U.S. Fish Wildl. Serv., Fish. Ind. Res. 4:73-78.
71. Khawaja, D. K., and A. K. Jafri. 1967. Biochemical changes in the muscle of the freshwater murrel. *Ophicephalus punctatus* Bloch during growth. Broteria Ser. Cienc. Nat. 36:71-84.
72. Khorana, M. L., M. L. Sarma, P. Seshagiri Rao, and K. V. Giri. 1943. Investigations on the food value of fish and other marine products. Part II. The protein and mineral contents. Indian J. Med. Res. 31:25-27.
73. Klocke, J. F., T. Porter, P. I. Tack, E. Leffler, N. S. Henry, and R. Nitchals. 1946. Nutritive value of fish from Michigan waters. I. Nicotinic acid of lake herring, carp, common suckers, and burbot. Food Res. 11:179-186.
74. Konosu, S., K. Fujimoto, Y. Takashima, T. Matsushita, and Y. Hashimoto. 1965. Constituents of the extracts and amino acids composition of the protein of short-necked clam. [In Jap., Engl. summ.] Bull. Jap. Soc. Sci. Fish. 31:680-686.
75. Konosu, S., S. Katori, R. Ota, S. Eguchi, and T. Mori. 1956. Amino acid composition of fish muscle protein [*In* Jap., Engl. summ] Bull. Jap. Soc. Sci. Fish 21:1163-1166.
76. Konosu, S., and T. Mori. 1959. Amino acid composition of shell-fish proteins. [In Jap., Engl. summ.] Bull. Jap. Soc. Sci. Fish 25:153-155.
77. Konosu, S., S. Katori, T. Akiyama, and T. Mori. 1958. Amino acid composition of crustacean muscle proteins. Bull. Jap. Soc. Sci. Fish. 24(4):300-304.
78. Koval'Chuk, G. K., and A. A. Titoba. 1970. Technological properties of yellowfin tunny from the Indian Ocean. [*In* Russ.] Rybn. Khoz. 46(2):65-69.
79. Landgraf, R. G., Jr. 1953. Alaska pollock: Proximate composition; amino acid, thiamine, and riboflavin content; use as mink feed. Tech. Note No. 27 Commer. Fish. Rev. 15(7):20-22.
80. Lee, C. F., and W. Clegg. 1955. Weight range, proximate composition, and thiaminase content of fish taken in shallow-water trawling in northern Gulf of Mexico. Tech. Note No. 31. Commer. Fish. Rev. 17(3):21-23.
81. Lee, C. F., and L. Pepper. 1956. Composition of southern oysters. Commer. Fish. Rev. 18(7):1-6.
82. Lee, C. F., C. H. Kurtzman, and L. Pepper. 1960. Proximate composition of southern oysters—factors affecting variability. Commer. Fish. Rev. 22(7):1-8.
83. Lindow, C. W., and W. H. Peterson. 1927. The manganese content of plant and animal materials. J. Biol. Chem. 75:169-175.
84. Lindow, C. W., C. A. Elvehjem, and W. H. Peterson. 1929. The copper content of plant and animal foods. J. Biol. Chem. 82:465-471.
85. Lopez-Matas, A., and C. R. Fellers. 1948. Composition and nutritive value of fresh, cooked, and processed swordfish. Food Res. 13:387-396.
86. Lovern, J. A., and H. Wood. 1937. Variations in the chemical composition of herring. J. Mar. Biol. Assoc. U.K. 22:281-293.
87. MacLennan, K. 1934. Herring as food. J. State Med. 42:588-598.
88. Mannan, A., D. I. Fraser, and W. J. Dyer. 1961a. Proximate composition of Canadian Atlantic fish. I. Variation in composition of different sections of the flesh of Atlantic halibut (*Hippoglossus hippoglussus*). J. Fish. Res. Board Can. 18:483-493.
89. 1961 b. Proximate composition of Canadian Atlantic fish. II. Mackerel, tuna, and swordfish. J. Fish. Res. Board Can. 18:495-499.
90. Master, F., and N. G. Magar. 1954. Studies in the nutritive value of Bombay fish. Part II. Amino-acid composition. Indian J. Med. Res. 42:509-513.
91. Masters, M., and R. A. McCance. 1939. CLIX. The sulphur content of foods. Biochem. J. 33:1304-1312.
92. Nagasawa, Y. 1958. Studies on the "browning" of canned crab meat (*Paralithodes camtschatica* Til.). I. The difference in the chemical composition of normal and browned canned crab meat. Bull. Jap. Soc. Sci. Fish. 24:535-540.
93. Neilands, J. B., R. J. Sirny, I. Sohljell, F. M. Strong, and C. A. Elvehjem. 1949. The nutritive value of canned foods. II. Amino acid content of fish and meat products. J. Nutr. 39:187-202.
94. Okey, R. 1945. Cholesterol content of foods. J. Am. Diet. Assoc. 21:341-344.
95. Ousterhout, L. E. 1960. Chemical composition and laboratory fillet yield of 13 species of middle and south Atlantic fish. Tech. Note No. 56. Commer. Fish. Rev. 22(7):15-16.
96. Peterson, W. H., and J. T. Skinner. 1931. Distribution of manganese in foods. J. Nutr. 4:419-426.
97. Phillips, A. M., Jr., D. R. Brockway, F. E. Lovelace, H. A. Podoliak. 1957. A chemical comparison of hatchery and wild brook trout. Prog. Fish-Cult. 19:19-25.
98. Polansky, M. M., and E. W. Toepfer. 1969. Vitamin B_6 components in some meats, fish, dairy products, and commercial infant formulas. J. Agric. Food Chem. 17:1394-1397.
99. Pugsley, L. I. 1941. The nutritive value of marine products. XV. Proximate analysis of canned British Columbia crabs, shrimps and clams. J. Fish. Res. Board Can. 5:344-346.
100. Qudrat-I-Khuda, M., H. N. De, N. M. Khan. 1962. Biochemical and nutritional studies of East Pakistan fish. Part. V.—Influence of age of fish on the distributional protein in their body. Pak. J. Sci. Ind. Res. 5:20-23.
101. Qudrat-I-Khuda, M., H. N. De., N. M. Khan, and J. C. Debnath. 1962. Biochemical and nutritional studies on East Pakistan fish. Part VII.—Chemical composition and quality of the traditionally processed fish. Pak. J. Sci. Ind. Res. 5:70-73.
102. Rodriguez, D. A., and M. C. Mendez Isla. 1952. Chemical studies of Spanish fishes. An. Bromato. 4:403-410.
103. Russell, E. S. 1923. Report on seasonal variations in the chemical composition of oysters. G. B. Minist. Agric. Fish., Fish. Invest. Ser. II, Vol. VI, No. 1, 24 p.
104. Saha, K. C., and B. C. Guha. 1939. Nutritional investigations on Bengal fish. Indian J. Med. Res. 26:921-927.
105. Saha, K. C., and N. C. Ghosh. 1941. Nutritional investigations on fish. Ann. Biochem. Exp. Med. 1(2):159-162.
106. Sakaguchi, M., M. Hujita, and W. Simidu. 1964. Studies on muscle of aquatic animals.-XXXXIII. Creatine and creatinine contents in fish muscle extractives. Bull. Jap. Soc. Sci. Fish. 30:999-1002.
107. Sakaguchi, M. and W. Simidu. 1964. Studies on muscle of aquatic animals.—XXXXLV. Amino acids, trimethylamine oxide, creatine, creatinine and nucleotides in fish muscle extractives. [*In* Jap., Engl. summ.] Bull. Jap Soc. Sci. Fish. 30:1003-1007.
108. Santos, F. O., and S. J. Ascalon. 1931. Amount of nutrients in Philippine food materials. Philipp. Agric. Rev. 20(1):402-409.
109. Sawant, P. L., and N. G. Magar. 1961. Studies on frozen fish. II. Some chemical changes occurring during frozen storage. Food Technol. 15:347-350.
110. Schmidt, P. J. 1948. Analyses of freshwater fishes from Canadian interior provinces. Fish. Res. Board Can. Pac. Coast Stn., Prog. Rep. No. 75, p. 48-51.
111. Schroeder, H. A. 1970. Essential trace metals in man: molybdenum. J. Chronic Dis. 23:481-499.
112. Setna, S. R., P. N. Sarangdhar, and N. V. Ganpule. 1944. Nutritive values of some marine fishes of Bombay. Indian J. Med. Res. 32:171-176.
113. Shaikhmahamud, F. S. 1961. Studies in the nutritive value of Bombay prawns: Part II. J. Sci. Ind. Res. Sect. D, 20:157-158.
114. Shaikhmahamud, F., and N. G. Magar. 1957. Studies in the nutritive value of Bombay prawns: Part I—Chemical composition of prawns. J. Sci. Ind. Res. Sect. A, 16:44-46.
115. Shimada, K., and E. Tanaka. 1936. Distribution of inositol in fish. [*In* Jap., Engl. summ.] Bull. Jap. Soc. Sci. Fish. 4:305-306.
116. Shostrom, O. E., R. W. Clough, and E. D. Clark. 1924. A chemical study of canned salmon. I. Variations in composition of the Pacific Coast salmons and steelhead trout as influenced by species and locality where caught. J. Ind. Eng. Chem. 16(3):283-289.
117. Sinnhuber, R. O., T. C. Yu, T. Chang Yu, and N. L. Karrick. 1956. Variation in proximate composition of right and left fillets or rockfish (*Sebastodes pinninger*) and dover sole (*Microstomus pacificus*). Commer. Fish. Rev. 18(12):24-26.
118. Sohn, B. I., J. H. Carver, and G. F. Mangan, Jr. 1961. Composition of commercially-important fish from New England waters. Part I—Proximate analyses of cod, haddock, Atlantic ocean perch, butterfish, and mackerel. Commer. Fish. Rev. 23(2):7-10.
119. Sohn, B. I., and M. A. Steinberg. 1962. Effect of cooking methods on the sodium content of halibut, haddock, and flounder. U.S. Fish Wildl. Serv., Fish. Ind. Res. 2(1):7-13.
120. Stansby, M. E., and H. S. Olcott. 1963. Composition of fish. *In* M. E. Stansby (editor), Industrial Fishery Technology, p. 339-349. Reinhold Publishing Corp., New York.
121. Sulit, J. I., O. B. Navarro, R. C. San Juan, and E. B. Caldito. 1953. Proximate chemical composition of various species

of Philippine market fishes. Phillip. J. Fish. 2:109-122.
122. Suyama, M., and Y. Sekine. 1965. Studies on the amino acid composition of shell-fish proteins. [*In* Jap., Engl. summ.] Bull. Jap. Soc. Sci. Fish. 31:634-637.
123. Tamura, E. 1957. Amino acid contents in Japanese foods. Annu. Rep. Nat. Inst. Nutr., p. 32.
124. Tanikawa, E., T. Wakasa, and Y. Nagasawa. 1958. Studies on the muscle meat of *Paralithodes camtschatica* (Til.)-(I). Bull. Fac. Fish., Hokkaido Univ. 9:227-257.
125. Teeri, A. E., M. E. Loughlin, and D. Josselyn. 1957. Nutritive value of fish. I. Nicotinic acid, riboflavin, vitamin B_{12}, and amino acids of various salt-water species. Food Res. 22:145-150.
126. Teply, L. J., P. H. Derse, C. H. Krieger, and C. A. Elvehjem. 1953. Nutritive value of canned foods; Vitamin B_6, Folic acid, beta-carotene, ascorbic acid, thiamine, riboflavin, and niacin content and proximate composition. J. Agric. Food Chem. 1:1204-1206.
127. Thomas, M. H., and D. H. Calloway. 1961. Nutritional value of dehydrated foods. J. Am. Diet. Assoc. 39:105-116.
128. Thompson, M. H. 1959a. Proximate composition of Gulf of Mexico industrial fish. Part 1—Winter and spring of 1958 studies. Commer. Fish. Rev. 21(2a):17-21.
129. 1959b. Proximate composition of Gulf of Mexico industrial fish. Part 2—Summer of 1958 studies. Commer. Fish. Rev. 21 (2a):21-23.
130. 1959c. Proximate composition of Gulf of Mexico industrial fish. Part 3—Fall studies (1958). Commer. Fish. Rev. 21(7): 16-20.
131. 1964. Cholesterol content of various species of shellfish. 1.—Method of analysis and preliminary survey of variables. U.S. Fish. Wildl. Serv., Fish. Ind. Res. 2(3):11-15.
132. 1966. Proximate composition of Gulf of Mexico industrial fish. U.S. Fish Wildl. Serv., Fish. Ind. Res. 3(2):29-67.
133. Thurston, C. E. 1958. Sodium and potassium in the edible portions of 34 species of fish. Commer. Fish. Rev. 20(1): 1-5.
134. 1958. Variation in composition of southeastern Alaska pink salmon. Food Res. 23:619-625.
135. 1961a. Proximate composition of nine species of sole and flounder. J. Agric. Food Chem. 9(4):313-316.
136. 1961b. Proximate composition of nine species of rockfish. J. Food Sci. 26:38-42.
137. 1961c. Proximate composition and sodium and potassium contents of four species of commercial bottom fish. J. Food Sci. 26:495-498.
138. 1962. Physical characteristics and chemical composition of two subspecies of lake trout. J. Fish. Res. Board Can. 19:39-44.
139. Thurston, C. E., and H. S. Groninger. 1959. Composition changes in Puget Sound pink salmon during storage in ice and in refrigerated brine. J. Agric. Food Chem. 7(4):282-284.
140. Thurston, C. E., M. E. Stansby, N. L. Karrick, D. T. Miyauchi, and W. C. Clegg. 1959. Composition of certain species of fresh-water fish. II. Comparative data for 21 species of lake and river fish. Food Res. 24:493-502.
141. Thurston, C. E., and P. P. MacMaster. 1960. Variations in chemical composition of different parts of halibut flesh. Food Res. 25:229-236.
142. Thurston, C. E., and H. W. Newman. 1962. Proximate composition changes in sockeye salmon *(Oncorhynchus nerka)* during spawning migration. U.S. Fish Wildl. Serv., Fish. Ind. Res. 2(1):15-22.
143. Valenzuela, A. 1928. Composition and nutritive value of Philippine food fishes. Philipp. J. Sci. 36:235-242.
144. Van Wyk, G. F. 1944. South African fish products. Part VIII. Composition of the flesh of cape fishes. J. Soc. Chem. Ind. 63:367-371.
145. Venkataraman, R., and S. T. Chari. 1951. Seasonal variation in the chemical composition of mackerel *(Rastrelliger kanagurta* Russel). Proc. Indian Acad. Sci. Sect. B, 33:126-134.
146. 1951b. Studies on oysters and clams: biochemical variations. Indian J. Med. Res. 39:533-541.
147. Walker, M., N. S. Wenkam, and C. D. Miller. 1958. Composition of some Hawaii fish. Hawaii Med. J. 18:144.
148. Wangler, J. G. 1960. Seasonal variations of physical characteristics and chemical composition of fish from middle Atlantic states. Commer. Fish. Rev. 22(7): 17-20.
149. Watson, V. K., and C. R. Fellers. 1935. Nutritive value of the blue crab *(Callinectes sapidus)*, and sand crab *(Platyonichus ocellatus* Latreille). Trans. Am. Fish. Soc. 65:342-349.
150. Webb, N. B., F. B. Thomas, F. F. Busta, and R. J. Monroe. 1969. Variations in proximate composition of North Carolina scallop meats. J. Food Sci. 34:471-474.
151. Wertz, A. W., B. V. McKay, K. O. Esselen, and J. O. Holmes. 1944. The effect of institutional cooking methods on the vitamin content of food. II. Thiamine, riboflavin, nicotinic acid and pantothenic acid content of fish. Mass. Agric. Exp. Stn. Progr. Notes, No. 3, p. 1-4.
152. White, F. D. 1936a. The nutritive value of marine products. IX. Proximate analysis of British Columbia canned pilchard. J. Biol. Board. Can. 2:457-460.
153. 1936b. The nutritive value of marine products. X. Proximate analysis of ling cod. J. Biol. Board Can. 2:461-462.
154. Yanase, M. 1953. Studies on the vitamin B_{12} of aquatic animals—III. The vitamin B_{12} content of shell fish. Bull. Jap. Soc. Sci. Fish. 18:636-638.
155. Yaroslavtseva, L. D. 1966. Technochemical properties of some Indian Ocean fishes. [In Russ.] Rybn. Khoz. 42(1):60-64.

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MFR PAPER 1044

A highly competitive fish meal market is foreseen as the product finds its place among competitive protein sources.

Fish Meal: International Market Situation and the Future

JUKKA KOLHONEN

INTRODUCTION

During the past several months users of fish meal have been greatly concerned over the shortage and high prices of this protein feed ingredient. The Peruvian anchovy crisis has been a major cause of this concern and makes it difficult to evaluate the market. For protein producers, the situation has presented new opportunities.

SUPPLY

During the 10-year period previous to 1972, the world output of fish meal grew tremendously; then in 1972, it dropped sharply. The annual world output of fish meal more than doubled in the 7-year period 1961-68. Table 1 shows the development only since 1966, because comparable data for each nation are not available for earlier years. After continuous growth, the world output dropped slightly in 1969. World production increased again in 1970, and reached a peak of 5.3 million tons. A slight decline occurred in 1971, and a sharp drop followed in 1972. The 1972 production of 47 countries was 3.9 million tons—24 percent less than in 1971, and about 180,000 tons less than in 1966.

The growth, as well as the decline in world production, is related to developments in Peru. Peru's annual output in 1962 was 1.1 million tons, or 40 percent of the world output. In the following years, Peru more or less held this share of the world production. In 1970, Peru's production of fish meal was at its peak, 2.3 million metric tons—42 percent of the world total. In 1971, Peru's production declined slightly; then in 1972, it dropped to about 900,000 tons—nearly 1,400,000 tons less than the peak year. Peru's production was still about 23 percent of the world total, mainly because of nearly normal production during the first half of the year. The impact of the oceanic condition known as El Niño was to be felt at the end of 1972 and in 1973. According to FAO scientists, overfishing was another factor in the decline. During the first half of 1973 the production of Peruvian fish meal was 370,000 metric tons, a considerable drop from the 1-million-ton average for the January-June period 1968-72.

Figure 1 indicates the strong influence of Peruvian production in the world output. It shows also that the production in the rest of the world has followed a somewhat similar trend. The total annual output of other fish meal producing countries, excluding Peru, expanded from 1961 to 1971 at an average rate of about 8 percent a year. In 1972, the production declined by 7 percent from the previous year, not only because of the drop in the anchovy catch in Chile—production also declined in South Africa, Norway, Canada, and the United States. The annual production of U.S. fish meal has varied between 200,000 and 250,000 metric tons during the past 5 years and has provided an average of about 40 percent of the available fish meal supplies in the United States.

World production data for the first half of 1973 are not available at this writing, but the production figures for the major exporting countries suggest that the world output has declined further. The figures show also that the aggregate output of fish meal in major exporting countries other than Peru in January-June this year had not increased from the same period in 1972 (Table 2).

DEMAND

In general, the size of the poultry and meat markets and the availability of other protein feeds influence the demand for fish meal. However, this generality tends to be more true in regions of the world where livestock feeding has developed into a sophisticated commercial feed mixing industry where computers are used to determine the least costly food formulas. The development of mixed feed industries is highly correlated with the level of general economic development of the area. In the less developed regions, livestock depend on what feed they can find.

Mixed feed industries are still largely limited to Western Europe, North America, and Japan (Table 3). The United States alone produced 52 percent of world mixed feeds in 1965. In 1971, U.S. production was 34

Jukka Kolhonen is an Industry Economist with the Market Research and Services Division, National Marine Fisheries Service, NOAA, Washington, DC 20235. His paper was originally presented at the Third Annual Inland Commercial Fishing Workshop (1973) in Fort Collins, Colo.

percent of the mixed feed production of 16 selected countries. This development indicates the expansion of formula feeding in the world. In recent years, other countries, especially in East Europe, have developed formula feeding. Table 3 shows a fast growth of the feed mixing industry in the Soviet Union.

World output of meat is another factor boosting the demand for fish meal and other high protein feed. World output of poultry meat increased at an average rate of 5.5 percent during the past 9 years, and the production of pork increased during the same time at an annual rate of 3 percent. U.S. broiler placements increased at an average annual rate of 4.9 percent during the same 9-year period, 1963-72.

The number of cattle in the world increased at an average rate of 1.5 percent during the same 9-year period. All these numbers indicate increasing demand for feed in the world, and together with the expansion of formula feeding suggest continuously increasing needs for high protein feeds, including fish meal.

PRICES

Simultaneously with the increase in the world consumption and production of fish meal until 1972, the prices of fish meal have fluctuated widely. After a sharp increase during the second half of 1965, prices of fish meal declined continuously until the first quarter of 1968. The quarterly average quotation in New York for 65 percent protein Peruvian meal was at that time $118 per short ton. Large stocks in the world were the major reason for the price decline.

Figure 2 shows the price development for fish meal and soybean meal from 1968 to 1973. Prices recovered quickly from the 1968 low, and by the last quarter of 1969, prices had surpassed the 1965 record level. The quotation in New York was about $200 per ton during the last quarter of 1969. After a decline during the

Table 1.—Annual production of fish meal (1000 metric tons).

Country	1966	1967	1968	1969	1970	1971	1972[1]
1. Peru	1471	1816	1922	1611	2253	1935	897
2. Japan (meal[2] and cakes)	359	410	484	580	656	670	580
3. USSR	239	294	326	348	369	406	410[8]
4. Norway	422	492	404	310	352	384	376
5. U.S.: meal	192	182	205	221	233	256	249
solubles[3]	38	34	33	37	43	50	61
6. S, SW Africa	268	355	476	411	308	273	245
7. Denmark	125	176	244	247	245	222	227
8. Chile	218	163	232	181	197	213	83
9. Angola	48	42	47	99	64	63	131
10. United Kingdom	87	81	88	86	85	91	89
11. Canada	90	91	124	128	112	91	72
12. Iceland	176	112	51	62	67	64	66
13. Germany F.R.[4]	82	83	82	78	72	73	54
14. Poland[2]	20	22	25	26	29	51	51[8]
15. Spain	34	33	39	40	34	34	45
16. Bermuda[5]	—	—	—	1	5	26	32
17. Mexico[2]	10	10	12	15	19	22	25
18. Thailand[6]	7	7	2	3	15	19	19[8]
19. France	14	13	14	14	20	25	18
20. Morocco[6]	37	25	38	28	30	19	17
21. Pakistan	8	7	9	12	13	10[7]	17[7]
22. Argentina	22	25	19	15	14	13	13[8]
23. Faeroes	8	11	15	12	15	16	13
24. Singapore[6]	7	9	10	11	11	9	10
25. Sweden	7	7	8	8	9	9	10
26. Panama[6]	12	12	9	4	7	11	9
27. Venezuela	5	6	7	8	8	8	8[8]
27 countries	4006	4518	4923	4595	5278	5063	3827
Other countries (20)	45[8]	38[8]	32[8]	46[8]	45[8]	50[8]	50[8]
47 countries	4051	4556	4955	4641	5323	5113	3877

[1] Preliminary data derived from miscellaneous sources.
[2] Including dry weight equivalents of small quantities of solubles.
[3] One-half of wet weight.
[4] Average moisture content 10 percent.
[5] UK import data.
[6] Export data.
[7] West Pakistan only.
[8] Preliminary or estimated
Source: Digest of 1967-1972 world statistics; International Association of Fish Meal Manufacturers

Table 2.—Production of fish meal in eight major exporting countries.

Countries	January-December 1971	January-December 1972	January-June 1972	January-June 1973
	Thousand metric tons			
Angola	63.0	130.7	57	71
Canada	91.2	72.2	24	18
Chile	213.3	83.0	54	40
Denmark	221.6	226.7	100[1]	70[1]
Iceland	63.9	66.3	62	82
Norway	384.4	375.5	255	211
Peru	1,935.0	897.0	843	370
South Africa	272.7	245.4	154	187
Total	3,245.1	2,096.8	1,549	1,049

[1] FEO estimate.

Table 3.—Production of mixed feed in selected countries.

Country	1970	1971	1972
	Million metric tons		
Austria	0.66	0.71	4.66
Belgium	4.28	4.28	4.66
Denmark	2.57	2.55	2.60[1]
France	7.58	8.36	9.61
Germany, FR	9.73	9.86	10.66
Iceland	0.97	1.06	1.18
Italy	3.63	3.71	4.02
Luxemburg	0.05[1]	0.08	0.10
Netherlands[2]	7.85	8.60	9.12
United Kingdom[3]	11.01	10.60	10.85
Canada[4]	7.06	7.35	7.99
U.S.[5]	56.60	55.05	55.05[1]
Argentina	0.98	1.23	1.58
South Africa	1.02	0.99	0.99[1]
Japan[6]	14.95	15.66	16.00[1]
USSR	23.70[1]	26.50[1]	28.00[1]
Total	152.64	156.99	167.07

Source: Digest of 1967-1972, World Statistics, IAFMM.
[1] Preliminary or estimated.
[2] August-July year.
[3] Compounds, balancers, concentrates.
[4] Actual tonnage of complete feed manufactured, plus estimated tonnage of complete feed from concentrates and supplements sold as such.
[5] Primary manufacturers only.
[6] Includes pet foods.

Table 4.—World output of poultry meat and pork.

	1961–65[1]	1970	1971	1972
	Thousand metric tons			
Poultry meat	11,603	17,673	18,200	18,992
Pork	30,784	37,142	39,708	40,154

[1]Annual average

next 2 years, prices increased sharply during the third quarter of 1972 in response to the Peruvian anchovy problem. The December average price for Peruvian meal in New York was $241 per short ton, and by May 1973 quotations averaged $480 per ton. The prices of domestic menhaden meal (60 percent protein) follow fairly closely the pattern of prices of Peruvian meal. In June 1973 when Peruvian meal prices were no longer quoted because of lack of supplies, menhaden meal prices reached an average of $508 per ton, compared with $175 a ton a year earlier. In July 1973, Peruvian meal reached $750 per metric ton, CIF Hamburg, West Germany. Expectations of the beginning of the Peruvian fishery and a high soybean crop reduced fish meal prices since midsummer 1973. New York quotation for menhaden meal was $410 to $430 per short ton in the middle of October 1973, and Peruvian meal CIF Hamburg on October 11, 1973 was quoted at $503 per metric ton ($457 per short ton).

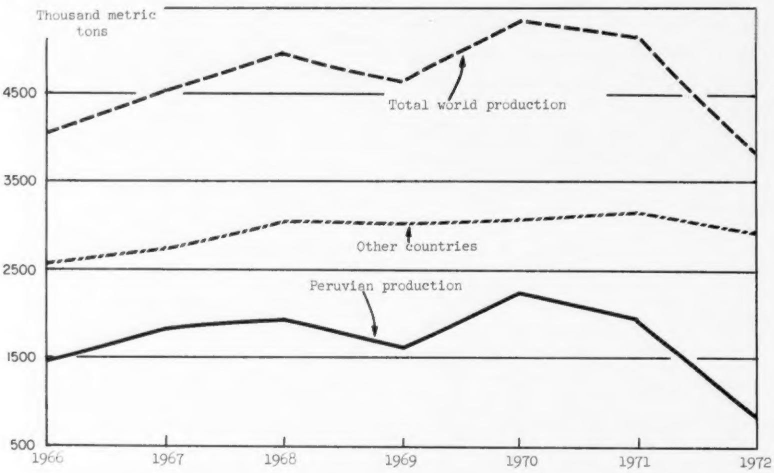


Figure 1.—World production of fish meal. Total world production figure includes data from 47 countries.

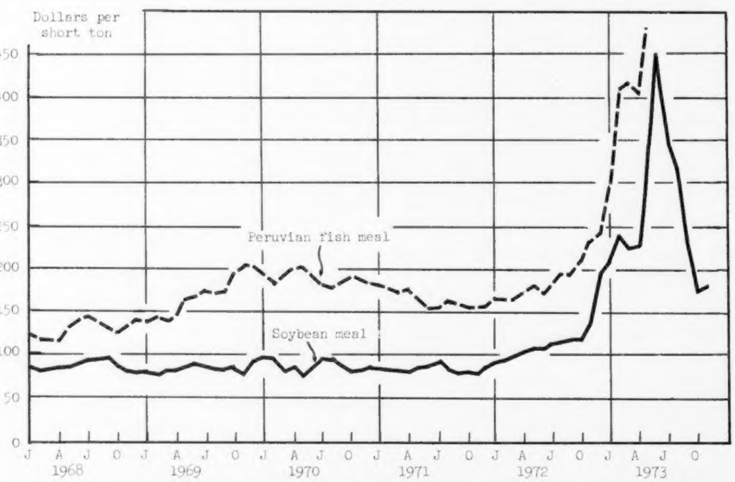


Figure 2.—Prices of Peruvian fish meal (65 percent protein, bulk, FOB east coast ports) and soybean meal (50 percent protein, bulk, at Decatur, Ill.) in the United States.

Except for price increases in the third quarter 1966 and 1972-73, the prices of soybean meal, which is the main competitor of fish meal, have been relatively steady over the past 7 years, fluctuating within 10 percent, up or down, of the average level for this period. In 1973, soybean meal prices quoted at Decatur, Ill., increased to a monthly average of $450 per ton in July, compared with $105 per ton a year before. Heavy export sales of soybeans and weather damage to the U.S. soybean crop in 1972 accentuated the protein shortages in the world and caused the price increase.

Because of the influence of wide fluctuation of prices of fish meal and the relatively steady price of soybean meal, with above-mentioned exceptions, the monthly average ratio of the price of fish meal to the price of soybean meal has fluctuated between 1.40 to 1, and 2.63 to 1 in the United States (Figure 3). In other words, a ton of fish meal has been from 1.4 to 2.6 times more expensive than a ton of soybean meal. Consequently, the percentage of fish meal in the feed mix has fluctuated. In broiler feed formula the fish meal percentage varies between a minimum of 2 percent and a maximum of 8 percent, depending on the relative prices of competing protein sources. This assumes, of course, that fish meal is available. The price ratio of fish meal to soybean meal has been very favorable to the use of a high percentage of fish meal in 1972 and 1973, if the alternatives between soybean meal and fish meal are considered. The effect of prices of fish meal and soybean meal on U.S. use of fish meal indicates a high degree of substitutability among these ingredients. The use of fish meal tends to change in the opposite direction with the price ratio of fish meal to soybean meal.

COMPETING PRODUCTS

The main competitors of fish meal as sources of protein are oilseed meals, mainly soybean meal, and various byproduct meals, for example, meat and

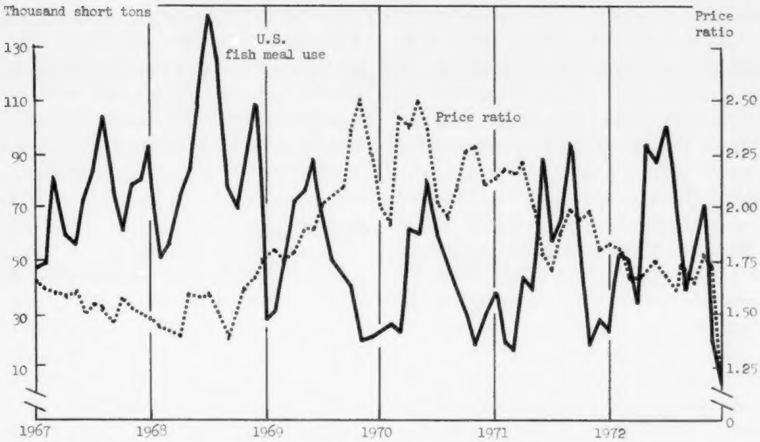


Figure 3.—United States fish meal use and fish meal-soybean meal price ratio.

bone meal. Although there is considerable substitution among various ingredients of high protein feeds, the interchangeability of these ingredients is limited owing to nutritional factors that arise primarily from differences in protein content and amino acid makeup of the protein.

Amino acid makeup is the crucial factor in the combination of feed ingredients to a feed formula. One reason that fish meal is regarded highly is that it is rich in lysine and methionine, which have particular nutritional importance. Vegetable proteins, and particularly the cereals, are deficient in lysine and methionine. Soybean meal is somewhat exceptional among vegetable proteins in having a high level of lysine, although it is deficient in methionine. Meat and bone meals are also good sources of lysine, but poor sources of methionine. The high levels of lysine and methionine in fish meals enable these deficiencies in the amino acid balance of the other feed ingredients to be corrected in a feed formula.

Several of the essential amino acids can also be produced synthetically, and as a result synthetic methionine and lysine are now being commercially manufactured. About 6 million pounds of methionine were used in poultry feed in the United States in 1961. By 1965, the use had doubled. The production capacity of manufacturers of synthetic methionine has greatly increased in recent years. The capacity of two Japanese firms almost doubled in 1971-72. In 1973 a French firm increased its capacity, a German firm decided to build a factory in Holland, and an Italian firm started production. The world shortage of fish meal has caused an increased demand for methionine and has given a permanent boost to the use of this product.

Lysine is a reasonably new product. It was manufactured first in 1967, and found a market in protein-rich feed formulas. Lysine has not had the same success as methionine, mainly because of its high price and its relatively great availability in soybean meal and fish meal. Nevertheless, the current protein crisis has created very strong demand for lysine, because it can replace some soybean meal in a feed formula. World supply is concentrated in two Japanese plants and reportedly one American plant. A French plant was scheduled to start production by late 1973 or early 1974.

The steep rise in fish meal prices in 1972 appears to have stimulated the development of other protein products also. Some 10 firms are currently concerned with production of single cell protein, which is more commonly known as protein from petroleum. By-products of the paper industry and the sugar industry provide similar opportunities for protein production.

The properties of single cell proteins are quite similar to the properties of fish meal (Table 5). Protein content in most single cell protein products is around 60 percent (fish meal 60-65 percent). Lysine content is generally slightly higher than in fish meal, but methionine content slightly less than in fish meal. Consequently, single cell proteins appear to have capability to replace fish meal in feed rations.

Single cell protein is produced currently by British Petroleum,[1] which plans to double production in 1974. An ICI plant in the United Kingdom is planned for 1976. Three firms in France are interested in producing single cell protein. Capacity of the existing plant will be increased by 1975, and two other plants may be completed in 1977. Japan has three plants under construction, but the work was interrupted at the request of public health officials. The construction may continue early in 1974. Construction of a plant in Italy was announced officially and should start production in 1974. Two other plants are planned.

OUTLOOK

It is estimated that the production of single cell proteins in the abovementioned countries could reach ½-million metric tons by 1977-78, and perhaps a million tons by 1980. This total is equal to about half the Peruvian fish meal production and about one-fifth of the world's production of fish meal before the Peruvian crisis.

The success of industrial protein products will depend greatly on the relationship between the prices at which these products can be sold and the prices of proteins from natural sources. If the plants producing single cell protein can increase productivity

[1] Use of trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Table 5.—Main characteristics of fish meal, soybean meal and various single cell proteins.

	As a percentage of the dry matter		
	Total Crude Protein	Of Soluble Lysine	Of Soluble Methionine
Fish meal (65%)	65.0	5.33	1.95
Soybean meal (50%)	50.0	3.30	0.65
Single cell proteins			
Enterprise A	57-63	6.4	1.5
Enterprise B	59	7.1	1.0
Enterprise C	60-63	7.5	1.8
Enterprise D	60	4.5	0.7
Enterprise E	66	7.8	1.6
Enterprise F	83	4.7	2.2

Source: OECD, Production and use of nitrogenous products of agricultural, marine, and industrial origin for animal feeding.

considerably, or if the prices of natural proteins increase or continue at the levels of last summer, industrial protein would become a serious competitor of fish meal.

The prices of fish meal and soybean meal have been declining since summer, 1973. Large soybean crops in the United States in the fall of 1973 (according to an October estimate, 24 percent higher than a year before), and increased Brazilian production are likely to cause a further decline in soybean meal prices in the short run. The decline in fish meal prices, although influenced by the soybean meal prices, is slowed somewhat by Peru's decision not to open its anchovy fishery this year. The earliest expected opening of the fishery would be this month (March 1974), and even then, fishing is expected to be conservative.

Figures for fish meal production in the rest of the world suggest that the very fast growth of world production of fish meal has come to an end. Increasing needs for fishery products for human consumption will reduce the possibilities to find additional resources for fish meal production. In the short-term, the world is likely to be short of fish meal. Although the Peruvian situation is temporary, the world supplies are not likely to be able to keep pace with demand if fish meal is used as a general source of low-cost protein. Feed mixing is becoming more sophisticated in the world, and the emphasis will be on amino acids, rather than on total protein content. As a result, the role of fish meal will change.

In the next 5-10 years, the fish meal industry will go through a revolution in the use of the product. In the long run, fish meal will be used as a unique small-quantity ingredient in high-quality feeds, rather than as a high-amount protein source. Fish meal will probably be used as an additive to human food also. This may be objectionable in some countries, but according to some European producers, fish meal is currently sold for human consumption.

Consequently, fish meal prices are expected to find a level considerably higher than prices before the Peruvian crisis. On the other hand, development of industrial protein will check the maximum level of prices. In the long run, the fish meal market will be highly competitive owing to the development of industrial protein and increasing sophistication of feed mixing in the world.

SUMMARY

Rapid growth of world production of fish meal was interrupted by a marked decrease in 1972. Major cause was the Peruvian anchovy crisis, but fish meal production of other countries has also declined.

The demand for fish meal is influenced by: (1) the development of sophisticated commercial feed mixing industry; (2) the size of the markets for poultry and meat; and (3) the availability of other protein feeds. All these three areas have been growing.

Fish meal prices increased substantially after 1972, but now there has been a slight decline because the world supplies of soybean protein are expected to improve.

Production of industrial protein is growing rapidly in the world. Single cell protein appears to have properties similar to those of fish meal.

The role of fish meal will change in the next 5 to 10 years. Fish meal will be used as a unique small-quantity ingredient in high-quality feeds rather than as a high-amount protein source.

MFR Paper 1044. From Marine Fisheries Review, *Vol. 36, No. 3, March 1974. Copies of this paper, in limited numbers, are available from D83, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235.*

U.S. Concerned Over Lack of Accord with Japan on Fisheries

Claiming that the sockeye salmon resource in Bristol Bay (Alaska) has decreased so drastically during recent years as to jeopardize the traditionally abundant stock, and that halibut stocks in the eastern Bering Sea are on the brink of extinction as a commercial resource, National Marine Fisheries Service Director Robert W. Schoning has criticized the Japanese for their failure to respond adequately to the two crucial conservation problems.

Mr. Schoning's remarks were made following the November meeting of the INPFC (International North Pacific Fisheries Commission) held in Tokyo. He attended as a representative of the Commerce Department's National Oceanic and Atmospheric Administration, the parent organization of NMFS, and as an alternate Commissioner of the INPFC. Other Commissioner representatives on the U.S. delegation in Tokyo were Elmer E. Rasmuson, Donald L. McKernan, and Chairman Milton E. Brooding. Member nations consist of Canada, Japan, and the United States.

The U.S. delegation had five basic objectives in an effort to resolve urgent conservation problems confronting U.S. fishermen in the North Pacific:

1. To seek adequate protection for Bristol Bay sockeye salmon in 1974;
2. To substantially reduce the incidental catch of juvenile halibut by Japanese trawlers in the eastern Bering Sea;
3. To prevent Japanese violations under the treaty[1] and the Commission's conservation recommendations by more stringent enforcement efforts by Japan;
4. To encourage study by scientists of the three member countries of the vulnerability of western Alaska chinook salmon to Japan's high-seas salmon fisheries; and,
5. To expand INPFC studies to include all fisheries resources in the Bering Sea.

[1]International Convention for the High Seas Fisheries of the North Pacific Ocean.

Describing the situation surrounding the Bristol Bay sockeye salmon as critical, Mr. Schoning said: "The expected run of five million sockeye salmon to Bristol Bay in 1974 is only about half our spawning requirement of nine million fish—and the State of Alaska contemplates no harvest in the major fisheries districts of Bristol Bay during the sockeye salmon season in 1974. In past years, these have been the largest sockeye salmon runs in the world."

He blamed adverse climatic conditions in recent winters for the 1973 "lowest return ever recorded of sockeye salmon to Bristol Bay," but added that small runs of the salmon *had* been predicted at the 1972 INPFC meeting and that the Japanese were aware of the need for cooperative conservation measures. At that time, Japan indicated it would operate its high-seas fishery with due concern for the Bristol Bay runs. Scientific information revealed at the recent Tokyo meeting clearly demonstrates, however, that Japan *increased* rather than decreased its fishing effort in 1973 in key areas where Bristol Bay sockeye salmon are vulnerable to capture during migration.

Mr. Schoning noted that evidence on hand shows clearly that any high-seas interception of Bristol Bay sockeye salmon in 1974 by the Japanese can have a strongly adverse effect on stock survival. As a preventive measure, the United States sought restrictions on salmon gillnetting in 1974 by the Japanese in high-seas areas when the Bristol Bay sockeye salmon is especially vulnerable to capture. The Japanese response, characterized by Mr. Schoning as "totally inadequate in view of the tremendous importance of Bristol Bay sockeye salmon to the livelihood of U.S. fishermen" merely noted an awareness of the problem but declined any assurance of positive action on the proposal that Japanese fishing practices be altered.

The drastic reduction in the abundance of halibut in the eastern Bering Sea is illustrated by data that show a massive decline in the North American setline fishery in the eastern Bering Sea, which dropped from a peak of 11 million pounds in 1963 to under 200,000 in 1973. Whereas 104 Canadian and U.S. vessels participated in the fishery in 1963, only 7 vessels fished in 1973—a 93 percent reduction in number of vessels. In contrast, in the same time frame, Japan increased its annual trawl catch in the same area by about 500 percent—to more than 4 billion pounds of fish in 1972—which in 1971 included 11 million pounds estimated as the "incidental" halibut catch.

Mr. Schoning stated that the major cause of decline in halibut stocks is mortality associated with the high incidental catch of juvenile halibut by the large trawl fleets of Japan and the Soviet Union, which results in the destruction of fish that, if allowed to achieve their full growth potential, would permit maintenance of a viable setline fishery. He noted that the best cooperative efforts of Canada and the United States, working toward restoration of halibut stocks through the International Pacific Halibut Commission (on which Mr. Schoning serves as a U.S. Commissioner) for 50 years, have, therefore, been unsuccessful, despite stringent conservation regulations imposed on North American setline fishermen.

At the Tokyo meeting, Canada and the United States, with the concurrence of scientists from the three member nations, urged that the INPFC adopt minimum conservation proposals aimed at protecting juvenile halibut from capture by trawls. The proposed measures were intended to effectively prevent the commercial extinction of this important food fish, yet minimize disruption to Japan's trawl fisheries.

The proposed restrictions would apply during periods when Japan's trawling effort is relatively low but coincides with periods when a high proportion (sometimes reaching 40 percent of total catch) of juvenile halibut is taken in trawl catches. Japan said, however, that it would not agree to the proposals because a substantial reduction in the halibut catch by trawlers also would result in a large decrease in trawl catches of other species.

Japan noted that it would take certain domestic actions to conserve the halibut resource, such as a continuation of the domestic size limit in the Bering Sea, maintenance of a large no-trawling area in the southeastern Bering Sea, and the placing of additional restrictions on trawling in specific periods and areas. Mr. Schoning said that the U.S. delegation views the domestic regulations proposed by Japan for 1974 as ineffective as a means of helping to restore the badly depeleted halibut resource in the eastern Bering Sea.

He added: "The U.S. and Canadian delegations were extremely distressed by Japan's negative attitude toward their conservation proposals which in our view, would have caused only a 10 percent loss in Japan's total trawl catch in the eastern Bering Sea. Whereas the United States and Canadian halibut fisheries in the eastern Bering Sea have, for all practical purposes, been eliminated, the Japanese appear to be fearful of the impact on their industry, which we look upon as minimal, particularly in view of evidence that a reduction is needed in trawling to maintain all elements of the complex of groundfish species at high levels of productivity.

"We are talking in these exchanges of protecting a valuable resource which is in imminent danger of commercial extinction, not just sharing the catch. North American fishermen have suffered from severe restrictions imposed on them by the United States and Canada over a period of years in efforts to save the halibut resource. Many of the fish we have refrained from taking in our continuing conservation efforts have not, however, accrued to either the resource or our fishermen, but rather have been taken by the expanding Japanese and Soviet trawl fisheries."

The INPFC meetings ended on a note of impasse with respect to the halibut issue inasmuch as a unanimous vote is a requisite to the adoption of new conservation measures. The United States and Canada may—as they have done in the past—adopt halibut conservation measures through the International Pacific Halibut Commission.

The U.S. delegation at the Tokyo meeting stressed its serious concern over continuing Japanese violations under the treaty. Clearly, some Japanese fishermen have been ignoring INPFC's conservation recommendations and Japan's domestic regulations as well. The Japanese delegation replied that violations of the treaty's salmon abstention provisions by Japanese nationals have been met with severe punishment. Japan promised that in 1974 it would increase patrols near the abstention line and would improve communications between patrol vessels and the salmon fleet. Mr. Schoning said he remains to be convinced, in view of previous assurances and unfavorable results as evidenced during 1973 when three Japanese vessels were caught fishing illegally for salmon in the Gulf of Alaska, 600 miles east of the abstention line.

Concerning halibut enforcement measures, the Japanese reported that they had increased substantially the number of inspectors aboard their trawl vessels in 1973; they said that in 1974 they would intensify enforcement of existing regulations with regard to halibut at ports of landing. The Japanese Government also agreed to permit U.S. scientific personnel aboard their trawl vessels in 1974 (as they did in 1972 and 1973), pending approval of such arrangements by the fishing companies, to observe the incidental catches of king and Tanner crabs, and halibut. Japanese spokesmen stated that they would adopt a law prohibiting the export of undersized halibut.

The NOAA-NMFS delegate, Mr. Schoning, said that preventing the export of undersized halibut—thus reducing the market incentive for capture—is helpful, but emphasized that the most effective action would be to put into effect strong measures to minimize the capture and resultant mortality of juvenile halibut taken by trawlers. To that suggestion Japan would not agree.

The Japanese delegation indicated a willingness to work with the United States and Canada in conducting research concerning the vulnerability of western Alaska chinook salmon to Japan's high-seas fishery in the central Bering Sea. The sharp increase in Japanese catches of chinook salmon, many believed to be from North American stocks, is of increasing concern to U.S. fisheries.

The NMFS Director said he was pleased that the Japanese delegation had reversed its 1972 position and agreed to accept the U.S. proposal that the Commission study all Bering Sea fisheries resources, whereas in the past the Commission had undertaken studies only on stocks taken in substantial quantities by more than one party. Of the three member nations of INPFC, only Japan carries on a substantial groundfishing effort in the Bering Sea. The United States is concerned about the total catches by foreign vessels in the area, and is determined to restore or maintain the various stocks—such as pollock, yellowfin sole, and shrimp—at an optimum level, though no extensive U.S. fishing effort is yet involved.

Ample evidence exists of an ecological inter-relationship among all stocks, which can be affected by an imbalance of populations of various species. In view of the tremendous expansion of total landings of all stocks in the Bering Sea (which have increased from about 28 million pounds in 1954 to nearly 5 billion

pounds in 1971), the United States has criticized Japan because of its narrow interpretation of the treaty, which in the past permitted Commission studies in the Bering Sea only as they related to halibut. Some fish hitherto precluded from scientific study by the Commission have been severely reduced in numbers.

"We went to Tokyo expecting responsible and meaningful action by the Commission in addressing these issues. Now it is abundantly clear that the United States should seek other alternatives designed to protect halibut and salmon in these areas and the livelihood of our fishermen, and to conserve all living resources in the North Pacific—resources that have been maintained too long to risk losing them now because of Japan's failure to take appropriate action," Mr. Schoning said.

The NMFS Director expressed the hope that the forthcoming Law of the Sea Conference scheduled for 1974, will lead to a meaningful solution to frustrating fisheries problems such as those experienced recently at the Tokyo conference.

New Acoustical Scanner of Seafloor Is Tested in Gulf for Fishery Application

The latest thing in seafloor surveyors has been tested in the Gulf of Mexico by fishery scientists of the Commerce Department's National Oceanic and Atmospheric Administration to develop information on underwater obstructions to fishing.

Called the "Shadowgraph System," the acoustical device looks like a torpedo with wings and is towed behind a ship. Its purpose is to convey information to the tow ship concerning configuration of the seafloor detected by electronics systems.

In the recent series of tests to determine the Shadowgraph System's capability as a fisheries research tool, personnel from NOAA's National Marine Fisheries Service deployed the instrument from the research vessel *Oregon II* jointly with the underwater photography sled called RUFAS (Remote Underwater Fisheries Assessment System), towed by the research vessel *George M. Bowers*. The two were used together so that the engineers could evaluate the merits of an acoustical image as opposed to an optical image of portions of the seafloor.

Participants in the experiment were the NMFS Southeast Fisheries Center (Miami, Fla.), the NMFS Fisheries Engineering Laboratory (Bay St. Louis, Miss.), Navy's Naval Coastal Systems Laboratory (Panama City, Fla.), NOAA's National Ocean Survey, and the U.S. Coast Guard. A committee consisting of representatives of the U.S. Geological Survey, the Louisiana Shrimp Association Offshore Oil Operator's Committee, the Bureau of Land Management, and the Corps of Engineers provided assistance and direction during planning phases.

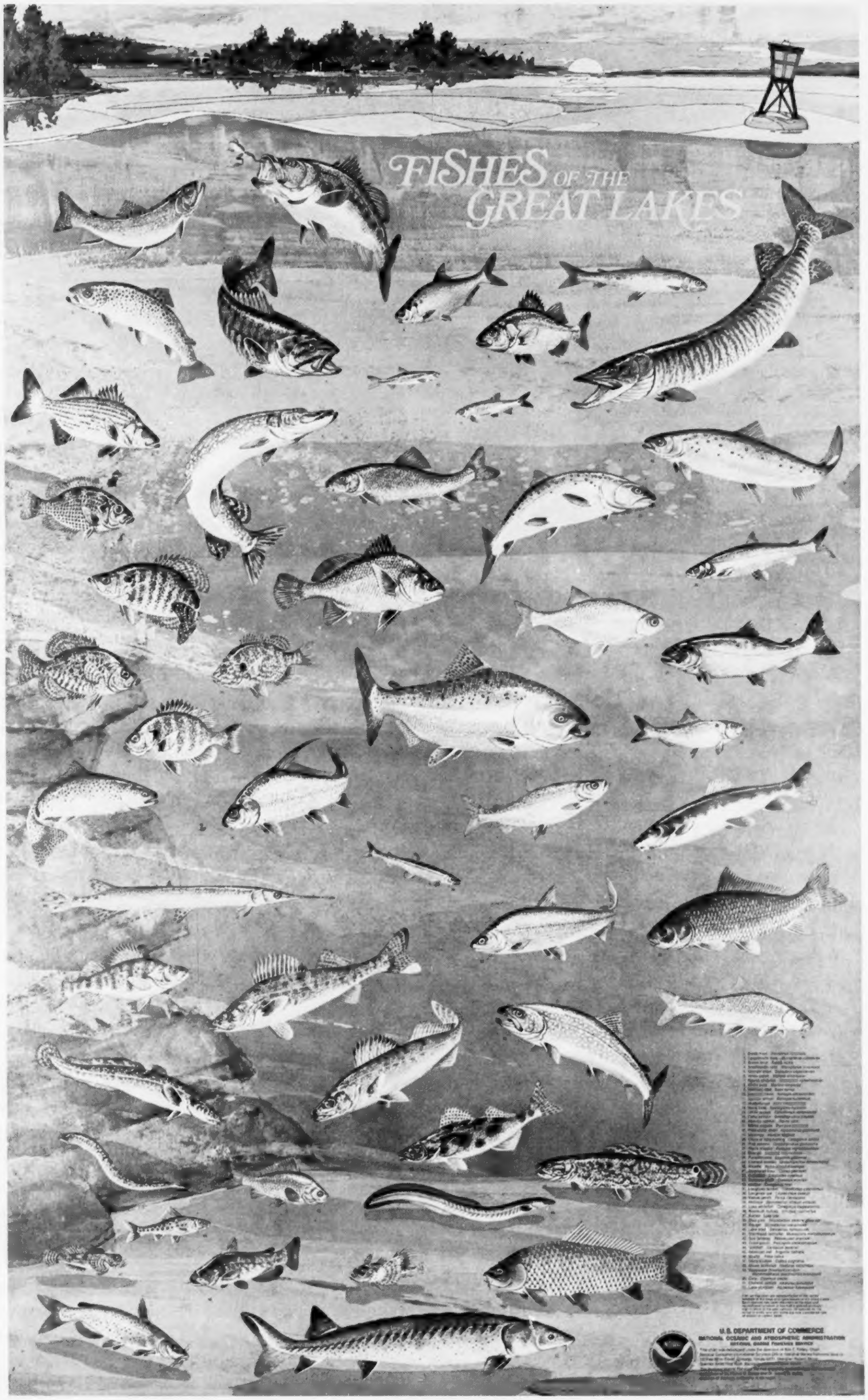
The Shadowgraph System, whose full name is the "Reconnaissance and Surveillance System C Mark 1 Mod C (Shadowgraph)" was developed by the Navy Department. Spearheading the two-week-long project were U.S. Representative John B. Breaux of Louisiana, and the Gulf States Marine Commission, in response to requests by Louisiana commercial fishermen for Government assistance in locating and marking underwater sites containing debris that fouled and snagged their fishing nets.

During a one-week feasibility test off Panama City, Fla., participants reported that they had been able to take acoustical "pictures" of objects such as 55-gallon drums. These and other targets were placed on predetermined spots on the ocean floor to test the resolution capability of the electronic system and the clarity of the images received aboard ship on an electric image scope and on strip charts. The latter provide a permanent record of data thus collected. The ships and their towed underwater vehicles ranged over waters off the Louisiana and Mississippi coasts. The Shadowgraph located and marked numerous bottom obstructions, and on several occasions scanned fish schools. The RUFAS system was rendered ineffective, however, because of high turbidity of the water during the study.

The Shadowgraph System's main feature is a torpedo- or fish-like device approximately 10 feet long and six feet wide, weighing about 450 pounds. The sonar-equipped winged cylinder, easily launched from the fantail of a ship, was towed in a search pattern over areas of interest at depths of 10 to 25 fathoms during the test. Its ability to side-scan, or "look" to right and left is considered an important asset in that it expands considerably the scanned area. Extremely high resolution is possible because of the high-frequency signals of the instrumentation. The picture-taking capability of the mechanical fish is based on the sonar principle in which a sound signal is bounced against an object encountered, bounced back to the instrumentation to reflect details of the scene under observation, and recorded via electronic circuitry on a pictorial receiver or scope.

After the experiment was completed, observers said that the Shadowgraph "appears to do an excellent job of obtaining bottom profile data," and that "a sufficient data base has been generated upon which a test could be designed that would resolve the question of marine resource assessment utilizing high resolution side scan sonar." They added that the tests provided a technique for deployment of side scan sonar from fisheries research vessels; and that the data base possible through additional work with the Shadowgraph System can provide the fishing industry with accurate and dependable information concerning underwater obstructions to fishing. Detailed findings have been presented before a meeting of the Gulf States Marine Fisheries Commission.

NMFS Issues Great Lakes Fish Poster



Great Lakes fish are the subject of the fifth in a series of fish posters, depicting aquatic inhabitants of U.S. waters that is issued by the Commerce Department's National Oceanic and Atmospheric Administration. The Director of NOAA's National Marine Fisheries Service, Robert W. Schoning, made the initial presentation in December 1973 at a Chicago (Ill.) meeting of the Seafood Council of Illinois, the Midwest Federated Fisheries Council, and NMFS representatives.

The latest four-color poster displays 52 species of fish that inhabit bays and open waters of the Great Lakes. Each species is or has been important to food and recreational fisheries of the region, or has special regional significance to Great Lakes ecology. All species do not occur in every Lake—some have become rarities in particular locations.

Developed by Bob E. Finley, Chief, Consumer Education Services Office of the NMFS, the 30-inch-wide by 48-inch-long charts are printed on washable non-glare plasticized paper that hangs flat against a surface without curling. A list of common and scientific names of the fishes is included, as well as artwork showing the natural habitat.

Copies may be ordered from Government bookstores and the Superintendent of Documents, Washington, DC 20402, for $1.75 for the latest poster, $2.00 for earlier ones.

NOAA Forms Ocean Remote Sensing Lab

A laboratory dedicated to studying the oceans from satellites, aircraft, and other remote platforms has been created in Miami, Fla., the U.S. Commerce Department's National Oceanic and Atmospheric Administration has announced.

The new Ocean Remote Sensing Laboratory will be one of the Atlantic Oceanographic and Meteorological Laboratories (part of NOAA's Environmental Research Laboratories, with headquarters in Boulder, Colo.) which occupy a major oceanographic research facility on Virginia Key near Miami.

According to Dr. John A. Apel, director, research emphasis will be on studying such physical and chemical aspects of the oceans, estuaries, and oceanic boundary layer as can be determined via remote sensing from spacecraft, aircraft, buoys, and ships; and to develop new instruments and techniques with which to do this.

"We have barely crossed the threshold of knowing how to use satellite sensors to observe the oceans," he says, "and technology in this area is progressing at an extremely rapid rate. We expect that 'ocean-tuned' satellites will eventually give oceanographers a flow of information and a breadth of vision comparable to that which meteorologists have had from weather satellites.

"At present we are conducting research that uses oceanic data from existing satellites—for example, the high-resolution images from NOAA spacecraft and NASA's first Earth Resources Technology Satellite, ERTS-1, which were not designed primarily to gather oceanic data. And we are helping guide programs in new ocean-looking satellites and sensors, now in their early development stages.

"The other side of our effort is to apply the remote-sensing tools of the trade to ocean research conducted from ships and aircraft. Some of these are microwave radiometers, laser and lidar (the laser equivalent of radar) sensors, acoustic sounders, infrared and visible sensors, precise radar altimeters, and microwave scatterometers."

Among the Ocean Remote Sensing Laboratory's planned projects are studies of major current systems and hurricane-ocean interactions using data from GEOS-C, the geodetic satellite planned for a 1974 launch; Gulf Steam dynamics and internal waves using data from the second Earth Resources Technology Satellite (ERTS); and various studies of surface and internal wave dynamics in the sea, using available satellite data and acoustic remote sensing from ships.

Foreign Fishery Developments

Petroleum Shortages Hit Fishing Vessels

CANADA'S FOREIGN FISH FUEL CUT SPARES U.S.

In view of possible shortages of petroleum products in Canada, the supply of fuel for foreign fishing vessels will be cut back. The order, announced November 30, 1973 under the Coastal Fisheries Protection Act, became effective immediately, according to Fisheries Minister Jack Davis.

It is anticipated that the kind of fuel that has been made available to foreign fishing vessels may be in short supply in the coming months. For this reason, the number of permits issued to foreign fishing vessels will be limited only to those which have customarily been calling at Canadian ports and which can also show that a genuine hardship will result if fuel is not made available to them.

Under no circumstances will fuel be supplied to foreign fishing vessels if there is any danger that Canadian requirements for fishing purposes cannot be met.

Because Canadian fishing vessels often fuel in United States ports as well as the fact that their vessels are traditional customers, the restrictions will not apply to United States fishing vessels. This arrangement will continue as long as reciprocal privileges are available to Canadian fishermen in United States ports.

OIL RATIONED FOR ICELANDIC VESSELS IN FOREIGN PORTS

Icelandic fishing vessels are now subject to oil rationing in many foreign ports, especially in Western Europe reports the Worldwide Information Service. In some ports the maximum has been set at 40 tons, and if more oil is requested, special permission has to be gained from London. There is no shortage of oil at present in Icelandic ports, yet foreign vessels do not get unlimited oil supplies.

Eighty percent of Iceland's oil supplies comes from the Soviet Union and this has been so since 1953. Originally the oil was bought in exchange for fish and fish products. The remaining 20 percent, which is mainly lubricants and aviation fuel, comes from the west.

Iceland's fishing fleet is heavily dependent upon Soviet oil. Prices are expected to go up tremendously and the foreseeable price increases in oil and fishing gear (produced from oil) are expected to cost the Icelandic fishing fleet at least US$12,000,000 in 1974. Many fear that the price of oil will go still higher.

Fishery Notes

Alaska Sockeye Salmon Get More State Protection

The Bristol Bay and Alaska Peninsula red salmon runs will be managed for maximum escapement next season under a policy adopted by the Board of Fish and Game.

Carl Rosier, director of the department's commercial fisheries division,

said that the board took the action because of predictions that the 1974 Bristol Bay sockeye salmon run is expected to fall far short of escapement needs and because red salmon returns to the Peninsula area are expected to be weak. Commercial fishing in the Bristol Bay, Chignik, and Alaska Peninsula areas will be permitted by emergency order and only limited fishing time can be expected if the runs return at the anticipated low levels.

The Department of Fish and Game has predicted that the Bristol Bay red salmon run, one of the state's most important fishery resources, will total only about five million fish in 1974. Escapement needs have been set at 9.5 million, nearly twice the amount of the predicted run. "Maximum escapement must be obtained if we are to salvage the great red salmon runs in this area," Rosier said. "The problem in Bristol Bay is not confined to 1974 and at this point we believe that a substantial harvest of Bristol Bay red salmon may not be possible for an entire five-year cycle."

Rosier said that the continued Japanese high seas salmon harvest is seriously compounding the problem of the Bristol Bay red salmon fishery.

"The Japanese intercept large numbers of red salmon bound for Bristol Bay and the Alaska Peninsula and although this has been pointed out to them as recently as last month at the International North Pacific Fisheries Commission meeting in Tokyo, they still refuse to consider taking steps to aid in the conservation of this valuable resource," Rosier said. (See also lead item, NOAA/NMFS Developments.)

"This intolerable situation left the Board of Fish and Game with little choice except to give maximum protection to the Bristol Bay red salmon runs to insure escapement of the returning adults," Rosier said. "Unless the escapement needs are met in the next few years we could be looking at the total collapse of the red salmon fisheries in Bristol Bay," Rosier added.

Oyster Harvester Being Developed

Scientists with the Virginia Institute of Marine Science have developed a prototype hydraulic escalator-type oyster harvester, according to the *Marine Resource Information Bulletin*, a VIMS publication. Results of field trials with the machine are described as "very encouraging," although further testing and modifications will be necessary before the dredge can be used commercially.

The oyster harvester utilizes the escalator system from the conventional Maryland-type soft clam harvester. However, the prototype boasts a completely new harvester head, designed to rake oysters from the bottom. The harvester head consists of a rectangular steel box with an inside width of 36-in, and an overall length of 36-in. The "box" narrows from 36-in to a width of 18-in where it attaches to the escalator. Inside this box are rows of flexible steel tines affixed to two steel cylinders. These cylinders are rotated by an underwater hydraulic motor. As the box slides on steel runners over the bottom (ahead of the escalator), the tines rake oysters and shells from the bottom. A horizontal jet of water washes them onto the escalator which carries them to the surface.

Initial tests demonstrated that the mechanical design of the apparatus was satisfactory; that the head containing the revolving tines attached satisfactorily to the present escalator system; and that all bearings, chain drives, and motors were fully operable, and the revolving tines dug into the bottom as designed. The work was supported on a matching basis by VIMS and the Virginia Marine Resources Commission under a contract with the National Marine Fisheries Service. More information on the oyster harvester is available from the Virginia Institute of Marine Science, Gloucester Point, VA 23062.

Reef Biology Symposium Set

An International Symposium on Indo-Pacific Tropical Reef Biology has been scheduled for June 23-July 5, 1974 on the islands of Guam and Palau in the Mariana and Caroline Islands groups by the Western Society of Naturalists.

Symposia will be held on "The Role of Benthic Algae in the Coral Reef Eco-System," and "Animal Associates of Coral." A three-session colloquium will deal with "The Need for Faunistic Information on Pacific Coral Reefs." Another meeting on Pacific Island Ecology, to be held on Palau, will consist of discussions and field trips dealing with local organisms as well as with ongoing mariculture and fisheries subsistence programs.

Contributed papers on a variety of subjects concerning the central theme of the Symposium will supplement the symposia and the colloquium. The symposia and paper sessions are planned as formal presentations, while the colloquium is regarded as a series of working sessions.

Each symposium will feature four or five invited speakers, with discussion periods following. Coloquium sessions will each list four invited speakers who will: (1) present the current status of a group of organisms; (2) discuss methods of completing gaps in the information available on the group; and (3) invite discussion as to programs and resource persons who might cooperate in such data gathering. A total of 12 scientists will thus address themselves to faunistic information profiles on Porifera, Reef and Deep Corals, Polychaetes, Bryozoans, Mollusca, Crustacea, Echinoderms, and Ascidians.

Sponsoring organizations and institutions include the Western Society of Naturalists; the Marine Laboratory, University of Guam; and the Trust Territories of the Pacific Islands, Department of Resources and Development.

Persons interested in participating in the Symposium should contact the Western Society of Naturalists, David H. Montgomery, Secretary, Department of Biological Sciences, California Polytechnic State University, San Luis Obispo, California 93407.

Ocean Engineering Conference Slated

The fifth of the I.E.E.E. Conferences on "Engineering in the Ocean Environment" will be held in Halifax, Nova Scotia, Canada, August 21 to 23, 1974. All major Canadian organizations concerned with oceanographic research and development are providing support.

The conference will emphasize research and development in "temperate and arctic waters" and technology developed for high latitude environments. Since the stress is on originality, major advances in other areas will be welcomed, especially those that have wide application to the oceans as a whole. Contributions should accentuate new technology developed in response to scientific and engineering needs or resulting from operational difficulties in achieving specific goals.

Invited and contributed papers will be presented in concurrent sessions. Plenary and informal evening sessions will deal with overlying considerations affecting ocean engineering such as economics, ocean resource management, and the law of the sea. An evening session outlining "Current Engineering Problems in Local East Coast Laboratories" has already been planned.

The following subjects will be on the agenda: pollution monitoring and control; exploitation of ocean resources; deep water fishing technology; data acquisition, reduction and processing; and many others.

For more information about the conference, write Ocean '74, P.O. Box 1000, Halifax, Nova Scotia, Canada.

Publications

Recent NMFS Scientific Publications

NMFS Extension Publication Fishery Facts-6. Hoopes, David T. **"Alaska's fishery resources—the Dungeness crab."** November 1973. 14 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ABSTRACT

Dungeness crabs, *Cancer magister*, occur in the inshore waters of the west coast of the United States and Alaska. Alaska production has averaged 9.2 million pounds annually since 1960; the yearly average value to the fishermen was between $1 and $2 million. A female may lay up to 1.5 million eggs, which adhere to small appendages under her abdomen until they hatch 7 to 10 mo later. After hatching, the minute larvae spend 3 to 4 mo in the water column as plankton. At the end of their planktonic development period, the larvae settle to the bottom and transform into juvenile crabs. Dungeness crabs grow only during the molting period. Males may live for 8 yr and attain 10 inches in width; females are considerably smaller. The commercial fishery takes only male crabs, which are caught in baited pots. Crabs are either delivered to market alive or are cooked and prepared in several ways. In Alaska the State Department of Fish and Game is responsible for conducting research required for rational management and protection of this valuable shellfish resource.

NOAA Technical Memorandum NMFS NWFC-1. Dangel, James R., Paul T. Macy, and Fred C. Withler. **"Annotated bibliography of interspecific hybridization of fishes of the subfamily Salmoninae."** November 1973. 48 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ABSTRACT

This bibliography of 611 annotated references lists published and unpublished material on hybridization between species of the subfamily Salmoninae and crosses of salmonids with non-salmonids. It does not include crosses within a species. The bibliography is indexed by species for the genera *Brachymystax*, *Hucho*, *Oncorhynchus*, *Salmo*, *Salmothymus*, and *Salvelinus* and certain non-salmonid species.

Data Report 79. Wolotira, Robert J., Jr. **"Trawl catches and oceanographic data from the NMFS groundfish survey in the eastern Bering Sea, 1972."** 108 p. (2 microfiche). For sale by U.S. Department of Commerce, National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22131.

ABSTRACT

Trawl catch and oceanographic data collected from the NOAA RV *Oregon* during the 1972 National Marine Fisheries Service (NMFS) eastern Bering Sea groundfish survey are presented. A total of 103 stations was sampled from May 26 to July 25. Station data are arranged in a tabular form and provide information on location, depth, time and distance trawled, type of fishing gear used, and species catch by weight. Bottom temperatures and salinities for each station are also included.

Data Report 80. Ingraham, W. James, Jr., and Donald M. Fisk. **"Physical oceanographic data from the north Pacific Ocean, 1972."** 131 p. (3 microfiche). For sale by U.S. Department of Commerce, National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22131.

ABSTRACT

Data on temperature and salinity versus depth were obtained from the RV *George B. Kelez* near Kodiak Island at 127 STD (salinity/temperature/depth) stations during April and May 1972. Values were digitized automatically during descent of the STD sensors to 1,500 m and stored on magnetic tape online with a shipboard PDP-8 computer. Secondary processing produced corrected temperature and salinity values and computations of sigma-t, sound velocity, anomaly of specific volume, and dynamic height—all of which are presented by standard depths.

In Defense of the Squid

• In the November number of *MFR*, I made some remarks on the preparation of squid that aroused the indignation of Richard Shomura, Director of the NMFS laboratory in Honolulu. He writes:

> "Sir, I resent your snide remark noted in the Editor's section of the November MFR issue that eating raw squid was like 'trying to chew your way through the sole of a tennis shoe.' Alas, your training in the gourmet sciences in Hawaii leaves much to be desired. In any event, I will try to set you straight. Firstly, eating raw squid on what you quaintly refer to as 'little rice patties' is strictly for the tourists. What one needs to start with is a fresh squid, preferably still panting and squirting. Clean the squid rapidly, slice diagonally across the grain in 3 by 5 cm sections, and set on a shallow, oval shaped procelain dish. Secondly, prepare a garnish made of soy sauce, fresh hot chili pepper. Thirdly, face the north pole if you are located in the northern hemisphere (the south pole if in the southern hemisphere), dip a piece of the squid sashimi into the sauce. Fourthly, with a slurping sound and with mucho gusto swallow the delicacy. The reason for the latter is to avoid ruining your taste buds; the reason for the former (direction to face) is to get as much of the polar winds into your windpipe as possible.
>
> "If you still feel the same after trying my recipe, I would suggest that you try chewing the soles of a little old lady's tennis shoes and then tell me that you prefer tennis shoes to raw squid."

My only alibi is that I have never—in either hemisphere—eaten squid prepared this way. Be willing to give it a try, though.

• W. L. Klawe of the Inter-American Tropical Tuna Commission has brought to my attention a possible misinterpretation of an article in the December number of *MFR:*

> "In the most recent issue of the Marine Fisheries Review I found something which I feel ought to be brought to your attention, as the same problem may arise in some articles which will be submitted for future publication.
>
> "Professor Konopa in his paper 'Marketing practices of retailers handling fish in the Akron and Cleveland areas' (*MFR* 36:12, p. 33-40) refers to recall of contaminated tuna as well as the pollution warnings and their impact on sales of canned products. What is more, by indirect implication he links presence of mercury (not mentioned by name) in tuna with pollution. From my own observation I find that the view that mercury in tuna is an outcome of pollution is very widely accepted. Although in the case of the trends in canned fish sales discussed in the article by Prof. Konopa, it did not matter whether the recall of tuna was because they were contaminated with a pollutant or naturally occurring substance, I think that it would be appropriate for your journal to point out the difference. I am sure that *Marine Fisheries Review* is read by a very large and widely diversified group and thus your journal has considerable influence on the formulation of public opinion relating to the marine fisheries. In such cases the reader should be given facts as accurate as is possible."

Right. Professor Konopa was dealing with the public's "attitudes," not its understanding of the "facts." The facts on mercury in tuna are well set out in a paper of which Klawe is a coauthor, "Mercury in tunas: A review," by C. L. Peterson, W. L. Klawe, and G. D. Sharp, which appeared in the *Fishery Bulletin*, Vol. 71, No. 3, p. 603-613. The presence of mercury not only in tunas but also in other fishes is treated in another *Fishery Bulletin* paper, "Effects of regulatory guidelines on the intake of mercury from fish—the MECCA project," by Roland Finch, Vol. 71, No. 3, p. 615-626.

• These paragraphs are being written at what is but the onset of winter. Even so, it seems almost perverse to have arranged for the publication, in chill February, of the sun-drenched photographs that illustrated Aurelio Solórzano's article on sport fishing off Mexico, or, in bleak March, of the evocative picture on our cover of the lucky fisherman in Alaska.

It will be some months before the Alaskan scene can be repeated. But northwestern Mexico in February and March is at its best.

Some years ago, San Felipe, on the east coast of Baja, where one could buy the best of shrimp directly from the boats and could catch 100-pound totuava from the shore, was a favorite vacation spot and I believe still is. One camped on the dunes bordering a sea still warm enough in winter for swimming. (Although the nights were, well, nippy.) On the west coast of the Mexican mainland there are fine roads leading through the desert toward the tropics and the central plateau. One ritual of a trip along this coast was to stop at Guaymas to eat fresh-caught oysters in a brightly painted wooden pavilion on the shore. Some of the best fish I have ever tasted was eaten in restaurants in some of the towns of the Mexican west coast. Los Mochis, near Topolobampo Bay, comes to mind. And San Blas, farther south. There, if one got up early, one could see the fishermen bringing to the restaurants great gleaming fish slung over their shoulders. One particular delicacy I remember from that old pirate hangout, San Blas, is snook. I don't know if it was the *Centropomus ensiferus*, *C. parallelus*, *C. pectinatus*, or *C. undecimalis* of the American Fisheries Society's list, or any of them. Under any name, though, it was unforgettable.

T.A.M.

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